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U.S. Army Center for Health Promotion and Preventive Medicine

USCHPPM

PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-99 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE SURFACE TRIP FLARE

DEPARTMENT OF DEFENSE IDENTIFICATION CODE: L495

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and
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Readiness Thru Health

U.S. Army Center for Health Promotion and Preventive Medicine

The lineage of the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) can be traced back over 50 years. This organization began as the U.S. Army Industrial Hygiene Laboratory, established during the industrial buildup for World War II, under the direct supervision of the Army Surgeon General. Its original location was at the Johns Hopkins School of Hygiene and Public Health. Its mission was to conduct occupational health surveys and investigations within the Department of Defense's (DOD's) industrial production base. It was staffed with three personnel and had a limited annual operating budget of three thousand dollars.

Most recently, it became internationally known as the U.S. Army Environmental Hygiene Agency (AEHA). Its mission expanded to support worldwide preventive medicine programs of the Army, DOD, and other Federal agencies as directed by the Army Medical Command or the Office of The Surgeon General, through consultations, support services, investigations, on-site visits, and training.

On 1 August 1994, AEHA was redesignated the U.S. Army Center for Health Promotion and Preventive Medicine with a provisional status and a commanding general officer. On 1 October 1995, the nonprovisional status was approved with a mission of providing preventive medicine and health promotion leadership, direction, and services for America's Army.

The organization's quest has always been one of excellence and the provision of quality service. Today, its goal is to be an established world-class center of excellence for achieving and maintaining a fit, healthy, and ready force. To achieve that end, the CHPPM holds firmly to its values which are steeped in rich military heritage:

★ *Integrity is the foundation*
★ *Excellence is the standard*
★ *Customer satisfaction is the focus*
★ *Its people are the most valued resource*
★ *Continuous quality improvement is the pathway*

This organization stands on the threshold of even greater challenges and responsibilities. It has been reorganized and reengineered to support the Army of the future. The CHPPM now has three direct support activities located in Fort Meade, Maryland; Fort McPherson, Georgia; and Fitzsimons Army Medical Center, Aurora, Colorado; to provide responsive regional health promotion and preventive medicine support across the U.S. There are also two CHPPM overseas commands in Landstuhl, Germany and Camp Zama, Japan who contribute to the success of CHPPM's increasing global mission. As CHPPM moves into the 21st Century, new programs relating to fitness, health promotion, wellness, and disease surveillance are being added. As always, CHPPM stands firm in its commitment to Army readiness. It is an organization proud of its fine history, yet equally excited about its challenging future.

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U.S. Army Center for Health Promotion and Preventive Medicine
5158 Blackhawk Road
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14. ABSTRACT
This assessment evaluated the potential for human health effects to offsite residents breathing air emissions following use of the Surface Trip Flare during training exercises. The military uses pyrotechnics for signaling, obscuring, and illumination during training exercises to simulate battle conditions. Study results showed no protential for health risks to the hypothetical resident from inhalation of air emissions from the Surface Trip Flare. To conduct this study, air emissions from the Surface Trip Flare were collected in a test chamber (at Dugway Proving Grounds, UT. This information was then used in an air dispersion model to determine ambient air concentrations at a location 100 meters (downwind from the site where the item was activated. Modeled air concentrations were combined with exposure information to estimate the amount of substances the hypothetical resident breathes. This intake was combined with the substance's health information, to determine if there is a potential for health risks from inhjalation of these substances. The health risk included both long-term and short term exposures to the modeled substance concentrations. Study results showed no potential for helath risks from inhalation of air emissions from the Surface Trip Flare.

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DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

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PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-99 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE SURFACE TRIP FLARE

EXECUTIVE SUMMARY

This assessment looked at the potential for human health effects to offsite residents breathing the air emissions from the surface trip flare used during training exercises. Pyrotechnics, such as the surface trip flare, are used by the military for signaling, obscuring, and illuminating during training and combat. Study results showed that no adverse health impacts are expected, to the offsite residents, from inhalation of the air emissions from the surface trip flare.

To conduct this study, air emissions from the surface trip flare were collected in a test chamber (BangBox) at the Dugway Proving Ground, Dugway, Utah. This information was then used in an air dispersion model to determine ambient air concentrations at a location 100 meters (328 feet) downwind from the site where the surface trip flare is used. Since the training facility in this study is a hypothetical location, the air model used assumptions that provided conservative estimates of air concentrations.

Modeled air concentrations were combined with exposure information (e.g., number of exposures per year) to estimate the amount of substances the hypothetical resident breathes. This intake was combined with a substance's health information, which was obtained from agencies such as the U.S. Environmental Protection Agency, to determine potential health risks from inhalation of these substances.

The health risk study included both long-term (30 years) and short-term (15 minutes or 1-hour) exposures to modeled substance concentrations. Study results showed no potential for health risks to the hypothetical resident from inhalation of substances released from the surface trip flare.

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LIST OF ACRONYMS

AEC	U.S. Army Environmental Center
AEGL	Acute Exposure Guideline Levels
AIHA	American Industrial Hygiene Association
Cr	Chromium
DODIC	Department of Defense Identification Code
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guidelines
HBSL	Health-Based Screening Level
HCl	Hydrochloric Acid (or Hydrogen Chloride)
mg	Milligram
NAAQS	National Ambient Air Quality Standards
NAC/AEGL	National Advisory Committee for Acute Exposure Guideline Levels
NEW	Net Explosive Weight
OEL	Occupational Exposure Limit
PM_{10}	Particulate Matter Under 10 Micrometers In Size
PRG	Preliminary Remediation Goals
RBC	Risk-Based Concentration
RfC	Reference Concentration
TEEL	Temporary Emergency Exposure Limits
TPCWG	Total Petroleum Criteria Working Group
TSP	Total Suspended Particulates

PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-99 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE SURFACE TRIP FLARE

1. PURPOSE

This document presents the evaluation of the potential for human health impacts to offsite residents who may be exposed to combustion products following the use of the surface trip flare.

2. AUTHORITY

Memorandum, U.S. Army Environmental Center, 4 June 1999, Subject: Pyrotechnics Risk Assessment.

3. REFERENCES

See Appendix A.

4. BACKGROUND

a. PYROTECHNICS AND THEIR USES.

The term pyrotechnics is derived from the Greek words "pyr" and "technē" meaning fire and art, respectively. This term is often used interchangeably with the term firework. Examples of pyrotechnics include distress flares and fireworks for commercial (e.g., public displays) and consumer (e.g., sparklers) use. Every year, during Independence Day and New Year's Eve, fireworks are used for public displays across the country. During the 1998 Olympic Wintergames in Nagano, Japan, almost 5000 pyrotechnics were launched during a firework display which lasted for 8 minutes.

The military uses pyrotechnics for four purposes: 1) as a method of communication through the use of signals, 2) to produce smoke to reduce enemy effectiveness, 3) for illuminating the field, and 4) to simulate battle conditions during training exercises. Pyrotechnics play an important role in both military training and combat. Therefore, it is important that our troops are adequately trained to use them properly.

b. WHAT IS THE SURFACE TRIP FLARE?

Surface trip flares are a type of pyrotechnics used primarily to warn our service men and women of infiltrating troops by lighting up the field. They may also be used for signaling.

The surface trip flare is about 5 inches long and 3 inches wide. When loaded, it weighs about 0.75 pounds. The surface trip flare contains a pyrotechnic charge that provides the bright light. This mixture is made up mostly of barium nitrate, which is also used to provide the white or green color in commercial or consumer fireworks.

c. USES OF THE SURFACE TRIP FLARE

The surface trip flare is a device used by our service men and women to protect themselves from enemies attempting to break through their defensive positions in the field. It is usually placed in front of their defensive lines to warn them when enemy soldiers approach (References 1, 2). Troops learn how to set up these devices during training exercises. These exercises also train them to be cautious when they are exposed to similar devices set by an enemy.

To prepare the surface trip flare for use, it is first attached to a sturdy object. A 50-foot trip wire is run across a path that is likely to be crossed by the enemy. When someone stumbles over this trip wire, the trip flare is set off, producing a very bright light that can burn for up to one minute. The bright light lights up the field, revealing the enemy's position and warning our troops that someone is coming.

d. ASSESSMENT SUMMARY

The general approach can be broken into two major parts: air dispersion modeling and exposure assessment. These are briefly discussed in the paragraphs below. Sections 5 through 7 present a more explicit discussion of the methodology used for this study.

Data generated in the "BangBox" at the Dugway Proving Ground, Utah (Reference 3), were used with an atmospheric dispersion model to estimate the average concentration that would be experienced by an offsite resident. As a conservative distance, it was assumed a person could reside 100 meters from the point of the surface trip flare activation. Since this study is designed to provide results that would be applicable to most Army training facility, the training area used in this evaluation is hypothetical. In addition, air modeling parameters were selected to mimic worst-case conditions.

The exposure assessment included calculating time-averaged concentrations for both long-term (chronic) and acute exposures. For the purpose of this study, air concentrations were averaged over 30 years and 1 hour, for chronic and acute exposures, respectively. Thirty years is the standard EPA default exposure duration for evaluating chronic residential exposures while 1 hour was selected primarily because of the availability of some established acute exposure data. These concentrations were then compared to chronic health-based screening levels established by various EPA regional offices, or short-term reference

concentrations from other sources, depending on the exposure duration (i.e., 30 years versus 1 hour).

5. METHODS AND DATA COLLECTION

a. EMISSION FACTORS

The air modeling emission rates were derived from the pyrotechnics emission studies conducted at Dugway Proving Ground, Utah (Reference 3). These studies sampled air emissions from the firing of weapons and/or munitions used in training. The purpose of this sampling was to identify and quantify air emissions. The data provided by Dugway Proving Ground included the identification of the munitions item and compounds sampled, net explosive weight (NEW) of item, and compound emission factors. Emissions data from this study are included in the first four columns of the air dispersion modeling output data in Appendix B.

b. AIR MODEL

(1) BACKGROUND

Air dispersion models are available to mathematically simulate atmospheric conditions and behavior to predict downwind concentrations caused by emissions from various sources. However, specific models are not available to estimate the dispersion of emissions from the use of munitions in training. The emissions from munitions used in training result in ambient concentrations of compounds at various locations. The magnitude and location of these concentrations depend on many factors including the amount and type of emissions, the behavior of the source, and meteorological conditions. Based on the evaluation of air dispersion models for military munitions, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) recommended using the Integrated PUFF (INPUFF) Model to estimate the dispersion of emissions from pyrotechnics (Reference 4).

(2) MODEL SELECTION

The INPUFF Model (Reference 5) was developed to simulate dispersion from instantaneous or semi-continuous point sources. This Gaussian-integrated puff model is capable of addressing a puff type release over short periods of time, and computations can be performed for a single point source for multiple receptors. The algorithm used to calculate concentrations uses a vertically uniformed wind direction (with no chemical reaction) to compute the contribution of each puff at a receptor for each time step/interval.

(3) ASSUMPTIONS

Some assumptions were made to best represent the surface trip flare in the model. These assumptions were as follows:

(a) For unconventional sources with no physical stack dimensions, the initial horizontal and vertical dispersion values (σ_y and σ_z) of the released puff were used to define the dimensions of the puff. Therefore, plume rise and formation were not determined by characterizing flue gas exit velocity and stack diameter, as they are with conventional point sources. The initial dimensions were set to values measured during Dugway Proving Ground testing and the dispersion of the initial cloud was modeled. The physical dimensions, including height and length of the puff or cloud, were estimated from the thermograph data recorded at every time step. The data also included minimum, mean, and maximum temperature readings during the duration of the emission test and were used to define the flue gas exit temperature.

(b) The worst-case release scenario analysis was performed using EPA Risk Management Program Guidance (Reference 6). This guidance includes tables for estimating the footprint of chemical releases. These guidelines were intended to inform emergency responders of the worst possible accidental release, but not necessarily the most likely. The EPA has defined most default conditions for meteorological modeling parameters. Table 1 lists the parameters that were used in the model.

(c) The resident used in this study was assumed to be directly downwind from the source. The meander of the puff is a major factor when estimating concentrations at given locations downwind from the source. Assuming that the resident is directly downwind from the source is the same as assuming that there is no puff meander and provides the most conservative modeled concentrations.

(d) Emissions were assumed to be emitted from a single representative source. This method is more conservative than the assumption that several individual sources are emitted over an area. The EPA guidance document "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources" (Reference 6) recommends merging parameters for multiple sources that are within 100 meters of each other. For the purposes of this study, an event was defined as the activation of one item per event. For more information on how this output data was used to evaluate exposure, see Section 5c (Exposure Assessment).

TABLE 1: AIR MODEL INPUT PARAMETERS

MODEL PARAMETERS	
Number of meteorological periods (NTIME)	1
Duration of each meteorological period (ITIME)	350 s
Number of updates to the source (NSRCDS)	50
Duration/time step between each source update (ISUPDT)	7 s
Total time modeled/Simulation Period (NTIME * ITIME) (NTIME * ITIME = NSRCDS * ISUPDT)	350 s
SOURCE PARAMETERS	
Source/Stack Diameter	0.20 m
Source/Stack Height	0.18 m
Source Exit Temperature	Varied every time step (7 s) degrees Kelvin (K)
Exit Velocity	NA
Emission Rate	UNIT EMISSION RATE OF 1 gram/second
Initial horizontal dispersion (σ_y)	Varied every time step for each puff emitted (7 s)
Initial vertical dispersion (σ_z)	Varied every time step for each puff emitted (7 s)
WORST CASE METEOROLOGICAL PARAMETERS	
Wind Speed	1 m/s
Atmospheric Stability	Category F
Wind Direction	270°
Ambient Temperature	293 degrees Kelvin (K) (or 68 °F)
Worst case Receptor Location	100 m directly downwind

(4) GENERAL METHODOLOGY

(a) The INPUFF model determined the amount of time it would take for the puff to pass over a location 100 meters (m) downwind. The released puff migrated at the constant wind speed of one meter per second (1 m/s) downwind from the point of activation. Assuming a distance of 100 m and a travel velocity of 1 m/s, it took 100 s for the center of each puff to reach this distance.

(b) The model was run for a total calculation time of 350 s to ensure that the total mass of the puff had passed the 100 m location and the thermograph data (recorded in 7 s intervals) could adequately simulate actual source behavior.

Therefore, each intermediate puff was assumed to have a time length of 350 s divided by 50 updates (or the puff lasted 7 s). Calculated concentrations every time step (7 s) indicated that the initial puff reached the receptor within 77 s and dissipated below the lowest concentration the model could calculate in this instance (1×10^{-9} g/m^3) within 196 s.

(5) USE OF MODEL OUTPUT

The concentrations provided by the INPUFF model were based on a unit emission rate of 1 g/s from an emission source and did not represent any pollutant-specific concentrations from the use of pyrotechnics. The relationship between the emission rate and predicted concentration is linear. Therefore, the ratio of the predicted concentration to the unit emission rate was multiplied by each pollutant-specific emission rate to provide pollutant-specific concentrations.

(6) DETERMINATION OF POLLUTANT-SPECIFIC EMISSION RATES

(a) The actual pollutant emission rate per item (ER_1) for each pollutant was calculated using the following equation:

$$ER_1 = \frac{M \cdot CV}{t} \qquad \text{Equation 1}$$

where:

ER_1 = emission rate for one item (g/(item*sec))
M = total mass (lb) of pollutant emitted per item (lb/item)
CV = conversion factor (453.59 g/lb)
t = release duration in seconds as obtained from the training manual (s) (References 2 and 8)

Example 1
Sample Calculation Using Equation 1*:

$$ER_1 = \frac{(1.726E-01)(453.59)}{(63)}$$

= 1.243E+00 g/(s*item)

* Calculation for TSP. Averaged adjusted emission factor of total suspended particulates (TSP) in lb/item was obtained from Appendix B.

(b) The pollutant emission rate for an event (ER_{EV}) for each pollutant was calculated using the estimated number of potential items used in a training event according to the following equation:

$$ER_{EV} = ER_1 \cdot I \qquad \text{Equation 2}$$

where:

ER_{EV} = emission rate for the estimated number of potential items used in a training event (g/s)
ER_1 = emission rate for one item (g/(item*sec))
I = items per event (item/event)

Example 2
Sample Calculation Using Equation 2*:

$ER_{EV} = (1.243E+00)(1)$

= 1.243E+00 g/s

* Calculation for TSP

(c) Pollutant-specific ambient concentrations for an event (CONC) were calculated using the following equation:

$$CONC = ER_{EV} \cdot \frac{UC}{ER_{unit}} \qquad \text{Equation 3}$$

where:

CONC = pollutant concentration based on the number of items used in a training event (g/m^3)
ER_{EV} = emission rate for the estimated number of items used in a training event (g/s)
ER_{unit} = unit emission rate as used in the model (g/sec)
UC = concentration based on the unit emission rate (g/m^3)

Example 3
Sample Calculation Using Equation 3*:

$$CONC = (1.243E+00)\frac{(5.135E-03)}{(1)}$$

= 6.383E-03 g/m^3

* Calculation for TSP (based on the activation of one item for the chronic evaluation)

c. EXPOSURE ASSESSMENT

(1) EXPOSURE ASSUMPTIONS

(a) Exposure assumptions were selected using a typical use scenario for the surface trip flare. This use scenario was developed based on consultation with the U.S. Army Environmental Center's (AEC) senior training advisor (References 9,10). The frequency of use of the surface trip flare was required to determine how much substance an off-post resident will be exposed to in the time period of interest (i.e., acute or chronic exposure). For the purposes of this study, a training scenario is defined as a day or session of training whereas a training event is defined as a single use of pyrotechnics. A training scenario may consist of multiple events. Table 2 summarizes the specific assumptions used to determine how often the surface trip flare is used during a training scenario.

TABLE 2: FREQUENCY OF USE FOR THE SURFACE TRIP FLARE

Parameter	Value Used
Number of items used per training scenario	10
Frequency of use	3 every 8 hours
Number of days per year the surface trip flare is used	5

(b) For the chronic and acute evaluations, air emissions were estimated based on the activation of one item per event. The puff that resulted from this event was modeled to a point 100 meters downwind. Since the unit emission rate was calculated using a runtime of 350 seconds, each event was also assumed to last 350 seconds (or 5.83 minutes).

(2) TIME-AVERAGING

For the chronic assessment, time-averaged concentrations were calculated using EPA's default residential exposure period of 30 years (this value assumes that the resident spends 30 years at the same residence). This was done to derive concentrations that would be consistent with the exposure duration used by the EPA so that estimated substance concentrations could be compared to their respective health-based screening levels.

In this evaluation, training scenarios occur approximately five times a year (References 9, 10). Using the default residence time established by the EPA, the assumption was made that someone could be exposed to five training scenarios per year for 30 years.

(a) The average daily concentrations were calculated using Equation 4. An example calculation using TSP is shown in Example 4. It should be noted that the average modeled concentration was converted from g/m^3 to $\mu g/m^3$ before it was used in Equation 4.

$$C_d = \frac{CONC \cdot ET \cdot EF_{day}}{1440} \qquad \text{Equation 4}$$

where:

C_d	= the average daily concentration ($\mu g/m^3$)
CONC	= average modeled concentration ($\mu g/m^3$)
ET	= exposure time (minutes/event)
EF_{day}	= number of events per day (events/day)
1440	= unit conversion from minutes to day

Example 4
Sample Calculation Using Equation 4:

$$C_{d\,(TSP)} = \frac{(6.383E+03)(5.83)(10)}{1440}$$

$$= 2.58E+02\ \mu g/m^3$$

Averaged modeled concentration of total suspended particulates (TSP) was obtained from Appendix B. The exposure parameters were obtained from Table 3.

(b) The average chronic concentrations were calculated using Equation 5. The resulting concentration (C_d) from Equation 4 was used in Equation 5 to determine the average chronic concentration. Example 5 shows how this calculation was performed.

$$C_{chronic} = \frac{C_d \cdot EF_{years} \cdot ED}{AT} \qquad \text{Equation 5}$$

where:

$C_{chronic}$ = average chronic concentration (µg/m^3)
C_d = average daily concentration (µg/m^3)
EF_{years} = number of days per year (days/year)
ED = exposure duration (yr)
AT = averaging time (days)
(for carcinogenic endpoint, AT = 70 years x 365 days; noncarcinogenic endpoint, AT = ED x 365 days)

Example 5
Sample Calculation Using Equation 5:

$$C_{chronic(TSP)} = \frac{(2.58\,\mathrm{E}+02)(5)(30)}{(30)(365)}$$

$$= 3.54\mathrm{E}{+}00\ \mu g/m^3$$

Averaged modeled concentration was calculated as shown in Example 4. The exposure parameters were obtained from Table 3.

(c) This study assumed that the same person would be exposed 5 days every year for 30 years. Since ten items could potentially be used per training day (See Table 2), ten events (EF_{day}) were characterized in the chronic evaluation to account for all ten items. For the acute evaluation, the air model results for one item were multiplied by three to account for the number of items that may be activated in 8 hours (3 every 8 hours). This conservatively assumes that all three items are activated within any hour of the 8 hour period. Table 3 summarizes the exposure parameters used in Equations 4 and 5.

TABLE 3: EXPOSURE PARAMETERS USED TO DETERMINE TIME-AVERAGED CHRONIC AIR CONCENTRATIONS

Exposure Parameter	Value Used
Exposure Time (ET)	5.8 minutes/event
Exposure Frequency (EF_{day})	10 events/day [a] 3 events/hour [b]
Exposure Frequency (EF_{year})	5 days/year
Exposure duration (ED), years	30 years

[a] Ten events used for the chronic evaluation since the air model was run for the activation of one item and ten items can be used in one day.
[b] Three events used for the acute evaluation since the air model was run for the activation of one item, and three items can be activated in one hour.

(d) Unlike the chronic evaluation, no clear guidance for evaluating acute exposures is currently available. Due to the nature of the use of pyrotechnics and the short duration of the concentration plume, however, acute exposures cannot be overlooked. For the purpose of this study, acute is defined as a 1-hour exposure. This is so that the estimated concentrations can be compared with guidelines developed specifically for emergency planning purposes (see discussion on acute toxicity below). This is a conservative assumption since the air model showed that the receptor is not expected to be exposed to more than 10 minutes of the concentration plume following activation of three surface trip flares.

(e) The average acute concentrations were computed using Equation 6. The exposure frequency is based on the number of events per hour or 15 minutes. Example 6 contains a sample calculation of this equation. Since TSP has no acute toxicity value, an acute concentration was not determined for this substance. Therefore, hydrochloric acid (HCl) was used for the example calculation.

$$C_{acute} = \frac{CONC \cdot ET \cdot EF_{hour}}{60} \qquad \text{Equation 6}$$

where:

C_{acute} = acute concentration ($\mu g/m^3$)
CONC = average modeled concentration ($\mu g/m^3$)
ET = exposure time (minutes/event)
EF_{hour} = exposure frequency (events/hour)
60 = unit conversion, 60 minutes/hour

Example 6
Sample Calculation Using Equation 6:

$$C_{acute(HCl)} = \frac{(2.382E-01)(5.83)(3)(1/0.25)}{60}$$

$$= 2.78E\text{-}01\ \mu g/m^3$$

The average acute concentration was obtained from Appendix B. For HCl, the acute toxicity value is based on a 15-minute exposure (TEEL-1). Therefore, the acute concentration was adjusted (1/0.25) so that C_{acute} can be compared with its toxicity value.

d. TOXICITY ASSESSMENT

The potential for health risks was determined by comparing time-averaged air concentrations to health-based screening levels which are typically developed from a substance's known toxicity. These toxicity values typically include different levels of safety factors depending on the level of confidence of the critical study. Appendix C contains a table of the screening values for both the chronic and the acute evaluations.

If the time-averaged air concentrations are below these screening levels, they are considered safe for everyone, including sensitive people such as the sick, elderly, and children. If the average modeled concentrations are greater than these screening levels, further analysis is warranted. It should be noted that concentrations greater than the screening levels do not indicate an onset of health effects, but rather the potential for such.

(1) CHRONIC ASSESSMENT

(a) The chronic assessment was evaluated using a screening approach. Using this method, a substance's estimated average concentration was compared to its health-based screening level. If this ratio was less than 1, no further analysis was required. The screening approach is conservative because the exposure assumptions used by the EPA assume that the resident is exposed for 350 days per year (this assumes 2 weeks of vacation per year). Since the training event in which the surface trip flare will be used is not expected to exceed 5 days per year, health-based levels specific to this study may be higher.

(b) Health-based screening levels were obtained from the EPA, primarily Region 3 and Region 9 (References 11, 12). The Internet sites of both regions were checked to ensure that the most recent information was used Although the

general approach used by both offices is the same, the exposure assumptions differ enough so that final recommended screening levels can vary to a certain degree. In both methods, a substance's health-based concentration is selected using the toxicity endpoint that derives a lower concentration. For example, if a substance has known systemic toxicity and is a carcinogen, concentrations were calculated using both toxicity information. The lower concentration was then chosen as the recommended screening level to maintain a conservative approach.

(c) A hierarchy was developed in order to quantitatively evaluate for as many of the identified substances as possible. Since the methodology used by Region 9 results in lower health-based screening levels than Region 3, the Region 9 preliminary remediation goals (PRGs) were used first. Region 3's risk-based concentrations (RBCs) were used only when a substance's PRG was not available. The only exception was for chromium(VI) [Cr(VI)] where Region 9 used a carcinogenic toxicity value that was seven times greater than EPA's recommended value (Reference 13) to develop its screening level for inhalation exposure. Since the EPA does not advocate the application of this multiplication factor, the RBC for Cr(VI) was used instead of the PRG.

(d) Some substances have neither PRGs nor RBCs because they have their own set of regulatory standards. Under the Clean Air Act, the EPA is required to set National Ambient Air Quality Standards (NAAQS) (Reference 14) for several substances considered harmful to public health and the environment. Currently, NAAQS are available for six substances, of which carbon monoxide, nitrogen dioxide, lead, sulfur dioxide and particulate < 10 micrometers (PM_{10}) have been detected in the surface trip flare Bang Box study. The NAAQS for the longer averaging time were used for the chronic evaluation. Depending on the substance, this can range from an 8-hour average to an annual average. In addition, since the majority of the measured total suspended particulates (TSP) were PM_{10} (Reference 3), the NAAQS for PM_{10} was used to evaluate potential health effects from exposure to TSP.

Example 7
Sample Calculation of Comparing a Substance's Estimated Chronic Concentration to Its Health-Based Screening Level:

$$\frac{C_{chronic(TSP)}}{HBSL} = \frac{3.54E+00}{5.0E+01}$$

$$= 7.08E\text{-}02 \text{ (or } 0.07) < 1$$

Note that HBSL is the health-based screening level of TSP. For TSP, the HBSL is based on the NAAQS. In this case, the resulting ratio is two orders of magnitude less than 1.

(e) Many petroleum hydrocarbons were detected but do not have specific screening levels. Therefore, the approach recommended by the Total Petroleum Criteria Working Group (Reference 15) was adopted to evaluate petroleum hydrocarbon mixtures. Based on the working group's assessment of various hydrocarbons, they recommended that mixtures be separated according to a substance's number of carbons and its chemical class (i.e., aliphatic or aromatic[1]). Generally, as a substance's carbon number increases, its molecular weight increases and it is, therefore, not a substance of concern via inhalation. The working group has also concluded that aromatic hydrocarbons tend to be more toxic than aliphatic hydrocarbons (Reference 15).

(f) Table 4 tabulates the inhalation toxicity values used to evaluate exposure to petroleum mixtures. To be consistent with the methodology used in this study, the reference concentrations (RfCs) were converted to PRGs using Region 9 assumptions. The resulting PRGs are shown in Table D-4.

TABLE 4: SUMMARY OF RfCs USED FOR PETROLEUM HYDROCARBONS (Reference 15)

Carbon Range	Aromatic Inhalation RfC (mg/m^3)	Aliphatic Inhalation RfC (mg/m^3)
$C_5 - C_6$ $C_{>6} - C_8$		18.4
$C_{>7} - C_8$	0.4	
$C_{>8} - C_{10}$ $C_{>10} - C_{12}$ $C_{>12} - C_{16}$	0.2	1.0
$C_{>16} - C_{21}$ $C_{>21} - C_{35}$	NA	NA

NA = not applicable for high molecular weight TPHs ($C_{>16}$) because compounds in this carbon range are not volatile and therefore, inhalation is not a pathway of concern.

(2) ACUTE ASSESSMENT

(a) As indicated previously, no acceptable method for assessing acute health impacts is currently available. It was not until recently that EPA guidance has addressed the need to evaluate acute health effects from inhalation (Reference 17). Even then, acute toxicity data for risk assessment purposes were not readily available. The EPA recognized this deficiency and spearheaded the National Advisory Committee for Acute Exposure Guideline

[1] Aliphatic hydrocarbons are hydrocarbons in which the carbon atoms are joined by single covalent bonds consisting of two shared electrons (e.g., butane). Aromatic hydrocarbons have ring structures (e.g., benzene). Source: Reference 16

Levels for Hazardous Substances (NAC/AEGL Committee). However, to date, AEGLs are only available for a handful of substances.

(b) To circumvent this problem, several state regulatory agencies have suggested that guidelines developed for emergency purposes be used in the interim. Although there have been suggestions to use occupational exposure limits (OELs) by applying additional safety factors (References 18, 19), OELs were not used in this study because they introduce even more uncertainty than the use of emergency guidelines. More uncertainty is introduced because OELs are designed to protect the workplace environment and assume 8 hours a day, 5 days a week exposures. By definition, these exposures are more chronic than acute.

(c) Emergency planning guidelines on the other hand, are more appropriate because they are typically developed for 1-hour exposures or less. In addition, safety factors may also have been included so that the values are protective of the general population.

(d) Emergency Response Planning Guidelines (ERPG) published by the American Industrial Hygiene Association (AIHA) (Reference 20) and the Temporary Emergency Exposure Limits (TEELs) developed by the Department of Energy (DOE) (Reference 21) were also used for this study, specifically the ERPG-1s and the TEEL-1s. Since TEEL-1s are intended for 15-minute exposures, air concentrations compared to TEELs were averaged over a 15-minute period as opposed to 1-hour in this assessment. This would not underestimate acute exposures to surface trip flare emissions because the concentration plume is not expected to last more than 10 minutes. The ERPG-1 and TEEL-1 are both similarly defined. The AIHA defines ERPG-1 as follows.

"The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

The DOE defines the TEEL-1s as follows:

"The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

(e) For this study, ERPGs were preferred over the TEELs because they are more vigorously reviewed before they are published, whereas the TEELs are not. Example 8 shows a sample calculation of how a substance's estimated acute concentration is compared to its acute toxicity value.

Example 8
Sample Calculation of Comparing a Substance's Estimated Acute Concentration to Its Acute Toxicity Value:

$$\frac{C_{acute(HCl)}}{ATV} = \frac{2.78E-01}{7.14E+03}$$

= 3.89E-05 (or 0.00004) < 1

Note that ATV is the acute toxicity value of HCl. In this case, the resulting ratio is five orders of magnitude less than 1.

6. RISK CHARACTERIZATION

Appendix D presents the results from the surface trip flare risk characterization. Note that for some substances, two concentrations were reported because of different analytical test methods. In those instances, the higher concentration was used.

a. CHRONIC HEALTH RISK

The outcome indicated that no chronic health risks are expected from breathing the air emissions from the surface trip flare. Since all ratios were below one, no further evaluation was needed. The highest ratio of 0.86 was estimated for chromium. It should be noted that chromium was assumed to be all Cr(VI) which is more toxic than Cr(III) via inhalation.

b. ACUTE HEALTH RISK

For the acute analysis, all ratios were below one, indicating that no acute health impacts are expected from breathing the air emissions from the surface trip flare. Since all ratios for the acute evaluation were below one, no further assessment was needed.

c. SUBSTANCES WITH NO TOXICITY DATA

Some substances were not quantitatively evaluated because they do not have established toxicity data. Comparing the concentrations of these substances to similar compounds with available toxicity data, it may be concluded that no potential for health effects would be expected from inhalation of these substances.

d. FACT SHEET

A copy of the fact sheet submitted to AEC is included in Appendix E. The fact sheet uses the results from this study to summarize health concerns related to inhalation of the air emissions from the surface trip flare.

7. UNCERTAINTY DISCUSSION

The limitations inherent in modeling and the added conservatism of the evaluation contribute to the uncertainty of the study results. In addition, the risk assessment methodology typically may include safety factors that are embedded in the toxicity data to ensure adequate protection of the general population, particularly, susceptible individuals such as children, the sick, and the elderly. Table 5 identifies various areas of uncertainty related to this assessment.

TABLE 5: TYPES OF UNCERTAINTY

Issue	Uncertainty	Direction of Effect
Modeling		
Modeled versus real-time sampling	The air concentrations in this study were modeled. Actual air concentrations taken from the field may be higher or lower.	Varies
Hypothetical resident assumed to be located directly downwind	Unless the area around the training facility is populated, the chances that a person living directly downwind is low.	Overestimates
Frequency of use for the surface trip flare	Actual frequency of use of surface trip flares during a training event may be different from those stated in this report.	Varies
Using worst-case meteorological conditions	To ensure that this study may be applicable to all training areas, worst-case meteorological conditions were used in the air model runs.	Overestimates
Exposure Assessment		
Estimating time-averaged concentrations	Actual exposure from the surface trip flare is intermittent. If one were to plot a person's exposure profile, the plot would consist of a series of spikes. Since current risk assessment methodology does not allow the evaluation of potential health risks as a function of time, a	Varies

Issue	Uncertainty	Direction of Effect
	single concentration, averaged over the exposure duration was used. In this study, the exposure durations used were 30 years and 1-hour.	
Chromium speciation	All chromium was assumed to be Cr(VI) which is more toxic than Cr(III).	Overestimates
Comparing estimated concentrations to established screening levels	The Region 3 and Region 9 health-based screening levels were developed using different exposure assumptions from those in this study. In this case, these assumptions resulted in more conservative screening levels.	Overestimates
Screening assessment versus calculating an average daily intake	Calculating an average daily intake allows the use of scenario-specific assumptions. However, unless the ratio of concentration to screening level approaches one, a screening assessment is useful as a first-cut evaluation.	Varies
Exposure to other munitions	Other munitions are typically used during the same training event. These items may contain substances that are similar or different from those detected in the surface trip flare.	Underestimates
Toxicity Assessment		
Lack of toxicity data	Some substances were not quantitatively evaluated because they have no known toxicity data.	Underestimates
Modifying and uncertainty factors for toxicity data	Modifying factors and uncertainty factors of varying degree are typically applied to toxicological values. These factors are used to account for different conditions such as extrapolating from animal studies for human health evaluation.	Overestimates

8. CONCLUSION

This study showed that residents who live as close as 100 meters directly downwind from the training facility are safe from inhalation of the air emissions from the surface trip flare. It is believed that the assumptions contained in this analysis are

conservative enough to be protective of all the population including the sick, elderly, and children.

9. RECOMMENDATIONS

Since the results from this study are intended for a hypothetical training facility, they can vary depending on site-specific conditions. However, because of the conservative assumptions used (e.g., worst-case meteorological conditions) it is believed that most site-specific analyses would result in even lower concentrations. Therefore, the results from this evaluation should be applicable to most training facilities unless site-specific conditions vary significantly.

10. POINT OF CONTACT

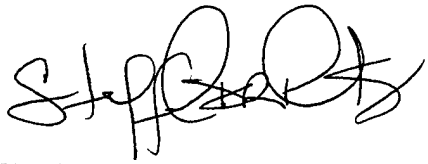
Questions about this report should be directed to Ms. Hsieng-Ye Chang at 1-800-222-9698 (ext 2953) or (410) 436-2953.

PREPARED BY:

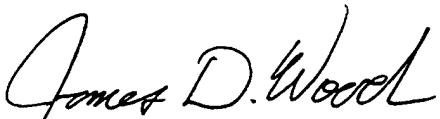
HSIENG-YE CHANG, P.E.
Environmental Engineer
Environmental Health Risk Assessment and Risk Communication Program

APPROVED BY:

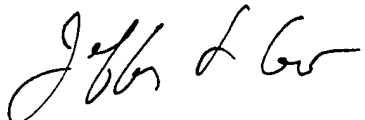
DAVID L. DAUGHDRILL
Program Manager
Environmental Health Risk Assessment and Risk Communication



STAFFORD D.F.R COAKLEY
Environmental Engineer
Environmental Health Risk Assessment and Risk Communication Program



JAMES D. WOOD, P.E.
Program Manager
Ambient Air Quality Management



JEFFREY S. GROW, P.E.
Supervisory Environmental Engineer
Ambient Air Quality Management Program

APPENDIX A

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APPENDIX B

AIR DISPERSION MODELING OUTPUT DATA

Table [illegible]: Air Modeling Output Data for Metals, Particulates, and Mis[illegible]aneous Compounds

	Simulator Surface Trip Flare				Items per event (I)	1	item/event	
	NEW, lb = 1.08				release duration (t):	63	seconds	
	Number of Items = 1				Unit Concentration (UC):	5.135E-03	g/m^3/(g/s)	
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/Item) M	**Pollutant Concentration 1 Item (grams/m^3)** CONC	Pollutant Emission Rate (g/sec)/Item ER_1	* Event Pollutant Emission Rate 1 Item (g/sec) ER_{EV}
Particulate								
TSP	7.666E+01	ND	1.597E-01	1.726E-01	7.831E+01	**6.383E-03**	1.243E+00	1.243E+00
PM_{10}	3.836E+01	ND	7.672E-02	8.294E-02	3.762E+01	**3.066E-03**	5.971E-01	5.971E-01
HCl/Cl_2								
HCl	1.455E-02	1.176E-02	5.960E-06	6.442E-06	2.922E-03	**2.382E-07**	4.638E-05	4.638E-05
Cl_2	3.133E-02	2.110E-02	2.207E-05	2.385E-05	1.082E-02	**8.819E-07**	1.717E-04	1.717E-04
Dioxin/Furan								
Dioxin TEQ	1.207E-10	ND	2.561E-13	2.769E-13	1.256E-10	**1.024E-14**	1.994E-12	1.994E-12
CEM System								
Carbon Monoxide (CO)	5.160E-01	2.572E-01	4.939E-04	5.339E-04	2.422E-01	**1.974E-05**	3.844E-03	3.844E-03
Nitrogen Oxide (NOx)	1.209E+00	3.673E-02	2.634E-03	2.847E-03	1.291E+00	**1.053E-04**	2.050E-02	2.050E-02
HCl	4.346E-01	5.379E-01	ND	ND	ND	**ND**	ND	ND
Carbon Dioxide (CO_2)	7.006E+02	6.659E+02	4.748E-02	5.133E-02	2.328E+01	**1.898E-03**	3.695E-01	3.695E-01
Sulfur Dioxide (SO_2)	3.748E-02	2.852E-03	8.902E-05	9.623E-05	4.365E-02	**3.558E-06**	6.928E-04	6.928E-04
Particulate-phase Metals								
Aluminum	7.170E-03	NM (a)	2.365E-05	2.557E-05	1.160E-02	**9.453E-07**	1.841E-04	1.841E-04
Antimony	4.931E-04	NM (a)	1.016E-06	1.098E-06	4.981E-04	**4.060E-08**	7.906E-06	7.906E-06
Arsenic	ND	NM (a)	ND	ND	ND	**ND**	ND	ND
Barium	4.384E-02	NM (a)	9.073E-05	9.808E-05	4.449E-02	**3.626E-06**	7.062E-04	7.062E-04
Beryllium	ND	NM (a)	ND	ND	ND	**ND**	ND	ND
Cadmium	1.067E-04	NM (a)	2.212E-07	2.392E-07	1.085E-04	**8.842E-09**	1.722E-06	1.722E-06
Chromium	6.654E-03	NM (a)	1.376E-05	1.488E-05	6.749E-03	**5.501E-07**	1.071E-04	1.071E-04
Cobalt	4.081E-04	NM (a)	8.501E-07	9.190E-07	4.168E-04	**3.398E-08**	6.616E-06	6.616E-06
Copper	3.532E-03	NM (a)	7.340E-06	7.935E-06	3.599E-03	**2.934E-07**	5.713E-05	5.713E-05
Lead	4.500E-03	NM (a)	9.370E-06	1.013E-05	4.594E-03	**3.745E-07**	7.292E-05	7.292E-05
Magnesium	1.053E+01	NM (a)	2.193E-02	2.371E-02	1.075E+01	**8.764E-04**	1.707E-01	1.707E-01
Manganese	1.324E-02	NM (a)	2.758E-05	2.981E-05	1.352E-02	**1.102E-06**	2.146E-04	2.146E-04
Nickel	1.644E-04	NM (a)	3.423E-07	3.700E-07	1.678E-04	**1.368E-08**	2.664E-06	2.664E-06
Phosphorus	5.765E-04	NM (a)	1.188E-06	1.284E-06	5.823E-04	**4.747E-08**	9.244E-06	9.244E-06
Selenium	ND	NM (a)	ND	ND	ND	**ND**	ND	ND
Silver	ND	NM (a)	ND	ND	ND	**ND**	ND	ND
Thallium	ND	NM (a)	ND	ND	ND	**ND**	ND	ND
Zinc	7.991E-02	NM (a)	1.665E-04	1.800E-04	8.166E-02	**6.656E-06**	1.296E-03	1.296E-03
Mercury	3.878E-05	NM (a)	8.073E-08	8.727E-08	3.958E-05	**3.226E-09**	6.283E-07	6.283E-07

Footnotes:
NM = Not Measureable
a: Insufficient material to analyze.
b: HCl/Cl_2 levels were too low to be reliably measured.

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

	Simulator Surface Trip Flare				Items per event (I):	1	item/event	
	NEW, lb = 1.08				release duration (t):	63	seconds	
	Number of Items = 1				Unit Concentration (UC):	5.135E-03	g/m³/(g/s)	
Compound	Measured Actual Concentration (mg/m³)	Measured Background Concentration (mg/m³)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 1 Item (grams/m³) CONC	Pollutant Emission Rate (g/sec)/Item ER_1	* Event Pollutant Emission Rate 1 Item (g/sec) ER_{EV}
Total Nonmethane Hydrocarbons (TNMHC)								
TNMHC	5.815E-02	5.455E-02	1.842E-05	1.992E-05	9.034E-03	**7.364E-07**	1.434E-04	1.434E-04
Volatile Organic Compounds (VOCs)								
Ethane	1.400E-03	1.150E-03	5.099E-07	5.512E-07	2.500E-04	**2.038E-08**	3.969E-06	3.969E-06
Ethylene	1.200E-03	1.500E-04	2.141E-06	2.315E-06	1.050E-03	**8.557E-08**	1.666E-05	1.666E-05
Acetylene	1.700E-03	4.500E-04	2.550E-06	2.756E-06	1.250E-03	**1.019E-07**	1.984E-05	1.984E-05
Propane	6.000E-04	6.000E-04	ND	ND	ND	**ND**	ND	ND
Propene	5.500E-04	2.000E-04	7.137E-07	7.715E-07	3.500E-04	**2.852E-08**	5.555E-06	5.555E-06
i-Butane	3.500E-04	3.000E-04	2.028E-07	2.193E-07	9.946E-05	**8.107E-09**	1.579E-06	1.579E-06
i-Butene	3.000E-04	1.000E-04	5.081E-07	5.492E-07	2.491E-04	**2.030E-08**	3.954E-06	3.954E-06
1-Butene	4.500E-04	ND	9.166E-07	9.908E-07	4.494E-04	**3.663E-08**	7.134E-06	7.134E-06
1,3-Butadiene	1.500E-04	ND	3.052E-07	3.299E-07	1.497E-04	**1.220E-08**	2.375E-06	2.375E-06
n-Butane	1.450E-03	1.000E-03	9.166E-07	9.908E-07	4.494E-04	**3.663E-08**	7.134E-06	7.134E-06
trans-2-Butene	ND	ND	ND	ND	ND	**ND**	ND	ND
2,2-Dimethylpropane	ND	ND	ND	ND	ND	**ND**	ND	ND
cis-2-Butene	ND	ND	ND	ND	ND	**ND**	ND	ND
3-Methyl-1-butene	ND	ND	ND	ND	ND	**ND**	ND	ND
i-Pentane	2.250E-03	1.750E-03	1.017E-06	1.099E-06	4.987E-04	**4.065E-08**	7.916E-06	7.916E-06
1-Pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methyl-1-butene	ND	ND	ND	ND	ND	**ND**	ND	ND
n-Pentane	1.700E-03	1.350E-03	7.128E-07	7.705E-07	3.495E-04	**2.849E-08**	5.548E-06	5.548E-06
Isoprene	ND	ND	ND	ND	ND	**ND**	ND	ND
trans-2-Pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
cis-2-Pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methyl-2-butene	ND	ND	ND	ND	ND	**ND**	ND	ND
2,2-Dimethylbutane	3.000E-04	3.000E-04	3.052E-07	3.299E-07	1.497E-04	**1.220E-08**	2.375E-06	2.375E-06
Cyclopentene	ND	ND	ND	ND	ND	**ND**	ND	ND
4-Methyl-1-pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
Cyclopentane	1.000E-04	2.000E-04	ND	ND	ND	**ND**	ND	ND
2,3-Dimethylbutane	3.000E-04	2.000E-04	2.028E-07	2.193E-07	9.946E-05	**8.107E-09**	1.579E-06	1.579E-06
cis-4-Methyl-2-pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methylpentane	9.500E-04	6.500E-04	6.095E-07	6.588E-07	2.988E-04	**2.436E-08**	4.744E-06	4.744E-06
3-Methylpentane	4.500E-04	4.500E-04	ND	ND	ND	**ND**	ND	ND
2-Methyl-1-pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
1-Hexene	2.000E-04	ND	4.094E-07	4.426E-07	2.008E-04	**1.636E-08**	3.187E-06	3.187E-06
n-Hexane	9.000E-04	7.000E-04	4.076E-07	4.406E-07	1.998E-04	**1.629E-08**	3.172E-06	3.172E-06
trans-2-Hexene	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methyl-2-pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
cis-2-Hexene	ND	ND	ND	ND	ND	**ND**	ND	ND
Methylcyclopentane	3.500E-04	7.000E-04	4.094E-07	4.426E-07	2.008E-04	**1.636E-08**	3.187E-06	3.187E-06
2,4-Dimethylpentane	2.000E-04	2.000E-04	ND	ND	ND	**ND**	ND	ND

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	**Pollutant Concentration 1 Item ($grams/m^3$)** CONC	Pollutant Emission Rate (g/sec)/item ER_1	* Event Pollutant Emission Rate 1 Item (g/sec) ER_{EV}
Benzene	2.500E-03	7.000E-04	3.673E-06	3.970E-06	1.801E-03	**1.468E-07**	2.859E-05	2.859E-05
Cyclohexane	5.000E-04	2.000E-04	4.057E-07	4.386E-07	1.989E-04	**1.621E-08**	3.158E-06	3.158E-06
2-Methylhexane	3.000E-04	3.500E-04	ND	ND	ND	**ND**	ND	ND
2,3-Dimethylpentane	4.000E-04	3.000E-04	4.057E-07	4.386E-07	1.989E-04	**1.621E-08**	3.158E-06	3.158E-06
3-Methylhexane	3.500E-04	6.000E-04	4.094E-07	4.426E-07	2.008E-04	**1.636E-08**	3.187E-06	3.187E-06
2,2,4-Trimethylpentane	1.300E-03	9.000E-04	8.151E-07	8.812E-07	3.997E-04	**3.258E-08**	6.344E-06	6.344E-06
n-Heptane	5.000E-04	4.000E-04	2.038E-07	2.203E-07	9.992E-05	**8.144E-09**	1.586E-06	1.586E-06
2,4,4-Trimethyl-1-pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
Methylcyclohexane	3.000E-04	2.500E-04	2.028E-07	2.193E-07	9.946E-05	**8.107E-09**	1.579E-06	1.579E-06
2,4,4-Trimethyl-2-pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
2,5-Dimethylhexane	1.000E-04	1.500E-04	ND	ND	ND	**ND**	ND	ND
2,4-Dimethylhexane	1.500E-04	1.500E-04	ND	ND	ND	**ND**	ND	ND
2,3,4-Trimethylpentane	3.000E-04	3.000E-04	ND	ND	ND	**ND**	ND	ND
Toluene	3.450E-03	2.400E-03	2.140E-06	2.314E-06	1.049E-03	**8.553E-08**	1.666E-05	1.666E-05
2,3-Dimethylhexane	2.000E-04	1.000E-04	2.038E-07	2.203E-07	9.992E-05	**8.144E-09**	1.586E-06	1.586E-06
2-Methylheptane	2.000E-04	1.500E-04	2.047E-07	2.213E-07	1.004E-04	**8.182E-09**	1.593E-06	1.593E-06
3-Ethylhexane	1.500E-04	1.500E-04	ND	ND	ND	**ND**	ND	ND
2,2-Dimethylheptane	ND	ND	ND	ND	ND	**ND**	ND	ND
2,2,4-Trimethylhexane	ND	1.000E-04	ND	ND	ND	**ND**	ND	ND
n-Octane	2.000E-04	1.500E-04	2.047E-07	2.213E-07	1.004E-04	**8.182E-09**	1.593E-06	1.593E-06
Ethylcyclohexane	ND	ND	ND	ND	ND	**ND**	ND	ND
Ethylbenzene	1.100E-03	1.950E-03	ND	ND	ND	**ND**	ND	ND
m-Xylene & p-Xylene	4.800E-03	9.350E-03	ND	ND	ND	**ND**	ND	ND
Styrene	4.400E-03	ND	8.972E-06	9.699E-06	4.399E-03	**3.586E-07**	6.983E-05	6.983E-05
o-Xylene	1.650E-03	3.600E-03	ND	ND	ND	**ND**	ND	ND
n-Nonane	7.500E-04	1.000E-04	1.322E-06	1.429E-06	6.483E-04	**5.284E-08**	1.029E-05	1.029E-05
i-Propylbenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
n-Propylbenzene	1.500E-04	1.500E-04	ND	ND	ND	**ND**	ND	ND
p-Ethyltoluene	4.500E-04	4.000E-04	2.047E-07	2.213E-07	1.004E-04	**8.182E-09**	1.593E-06	1.593E-06
m-Ethyltoluene	2.000E-04	2.500E-04	ND	ND	ND	**ND**	ND	ND
1,3,5-Trimethylbenzene	2.500E-04	2.500E-04	ND	ND	ND	**ND**	ND	ND
o-Ethyltoluene	2.000E-04	ND	4.057E-07	4.386E-07	1.989E-04	**1.621E-08**	3.158E-06	3.158E-06
1,2,4-Trimethylbenzene & sec-Butylbenzene	7.000E-04	6.500E-04	2.028E-07	2.193E-07	9.946E-05	**8.107E-09**	1.579E-06	1.579E-06
n-Decane	1.000E-04	1.000E-04	2.028E-07	2.193E-07	9.946E-05	**8.107E-09**	1.579E-06	1.579E-06
alpha-Pinene	ND	ND	ND	ND	ND	**ND**	ND	ND
beta-Pinene	ND	ND	ND	ND	ND	**ND**	ND	ND
delta 3-Carene	ND	ND	ND	ND	ND	**ND**	ND	ND
d-Limonene	ND	ND	ND	ND	ND	**ND**	ND	ND
MTBE	6.500E-04	ND	1.320E-06	1.427E-06	6.474E-04	**5.277E-08**	1.028E-05	1.028E-05
Dichlorodifluoromethane	1.497E-03	1.596E-03	2.489E-08	2.690E-08	1.220E-05	**9.947E-10**	1.937E-07	1.937E-07
Methylchloride	ND	ND	ND	ND	ND	**ND**	ND	ND
Dichlorotetrafluoroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
Chloroethene	ND	ND	ND	ND	ND	**ND**	ND	ND
1,3-Butadiene	2.034E-04	ND	4.126E-07	4.461E-07	2.023E-04	**1.649E-08**	3.212E-06	3.212E-06
Methylbromide	ND	ND	ND	ND	ND	**ND**	ND	ND
Ethylchloride	1.349E-04	ND	2.762E-07	2.985E-07	1.354E-04	**1.104E-08**	2.150E-06	2.150E-06
Trichloromonofluoromethane	2.723E-03	2.608E-03	2.355E-07	2.546E-07	1.155E-04	**9.412E-09**	1.833E-06	1.833E-06

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 1 Item ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/Item ER_1	* Event Pollutant Emission Rate 1 Item (g/sec) ER_{Ev}
Vinylidenechloride	ND	ND	ND	ND	ND	**ND**	ND	ND
Methylenechloride	1.155E-02	8.479E-04	2.175E-05	2.352E-05	1.067E-02	**8.694E-07**	1.693E-04	1.693E-04
Allylchloride	ND	ND	ND	ND	ND	**ND**	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	9.561E-04	9.618E-04	1.227E-07	1.326E-07	6.016E-05	**4.903E-09**	9.549E-07	9.549E-07
1,1-Dichloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2-Dichloroethene	ND	ND	ND	ND	ND	**ND**	ND	ND
Chloroform	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
Methylchloroform	3.203E-04	3.188E-04	2.706E-08	2.925E-08	1.327E-05	**1.082E-09**	2.106E-07	2.106E-07
Benzene	2.543E-03	7.120E-04	3.736E-06	4.038E-06	1.832E-03	**1.493E-07**	2.907E-05	2.907E-05
Carbontetrachloride	8.656E-04	7.376E-04	2.610E-07	2.821E-07	1.280E-04	**1.043E-08**	2.031E-06	2.031E-06
1,2-Dichloropropane	ND	ND	ND	ND	ND	**ND**	ND	ND
Trichloroethylene	ND	ND	ND	ND	ND	**ND**	ND	ND
cis 1,3-Dichloro-1-propene	ND	ND	ND	ND	ND	**ND**	ND	ND
trans 1,3-Dichloro-1-propene	ND	ND	ND	ND	ND	**ND**	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
Toluene	3.509E-03	2.441E-03	2.177E-06	2.353E-06	1.067E-03	**8.700E-08**	1.694E-05	1.694E-05
1,2-Dibromoethane	ND	ND	ND	ND	ND	**ND**	ND	ND
Perchloroethylene	ND	ND	ND	ND	ND	**ND**	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Ethylbenzene	1.689E-03	2.994E-03	ND	ND	ND	**ND**	ND	ND
m&p-Xylene	4.882E-03	9.510E-03	ND	ND	ND	**ND**	ND	ND
Styrene	4.475E-03	ND	9.126E-06	9.865E-06	4.475E-03	**3.647E-07**	7.103E-05	7.103E-05
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
o-Xylene	1.678E-03	3.662E-03	ND	ND	ND	**ND**	ND	ND
p-Ethyltoluene	4.577E-04	4.068E-04	2.082E-07	2.251E-07	1.021E-04	**8.322E-09**	1.621E-06	1.621E-06
1,3,5-Trimethylbenzene	5.086E-04	3.051E-04	4.126E-07	4.461E-07	2.023E-04	**1.649E-08**	3.212E-06	3.212E-06
1,2,4-Trimethylbenzene	7.120E-04	6.611E-04	2.063E-07	2.230E-07	1.012E-04	**8.246E-09**	1.606E-06	1.606E-06
Benzylchloride	ND	ND	ND	ND	ND	**ND**	ND	ND
m-Dichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
p-Dichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
o-Dichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	**ND**	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	**ND**	ND	ND
o-Chlorotoluene	ND	ND	ND	ND	ND	**ND**	ND	ND
p-Chlorotoluene	ND	ND	ND	ND	ND	**ND**	ND	ND
1,3,5-Trichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2,3-Trichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Methylnitrite	1.977E-04	ND	4.026E-07	4.353E-07	1.974E-04	**1.609E-08**	3.134E-06	3.134E-06
Acetonitrile	ND	ND	ND	ND	ND	**ND**	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	**ND**	ND	ND
Nitromethane	1.463E-03	ND	2.982E-06	3.223E-06	1.462E-03	**1.192E-07**	2.321E-05	2.321E-05
Benzonitrile	ND	ND	ND	ND	ND	**ND**	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Carbonyl Sulfide	ND	ND	ND	ND	ND	**ND**	ND	ND
Sulfur Dioxide	ND	ND	ND	ND	ND	**ND**	ND	ND

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	**Pollutant Concentration 1 Item ($grams/m^3$)** CONC	Pollutant Emission Rate (g/sec)/Item ER_1	* Event Pollutant Emission Rate 1 Item (g/sec) ER_{EV}
Carbon Disulfide	7.518E-04	9.532E-04	7.454E-07	8.058E-07	3.655E-04	**2.979E-08**	5.802E-06	5.802E-06
Thiophene	ND	ND	ND	ND	ND	**ND**	ND	ND
Dimethyldisulfide	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methylthiophene	ND	ND	ND	ND	ND	**ND**	ND	ND
3-Methylthiophene	ND	ND	ND	ND	ND	**ND**	ND	ND
Dimethyltrisulfide	ND	ND	ND	ND	ND	**ND**	ND	ND
Isothiocyanatomethane	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Chlorothiophene	ND	ND	ND	ND	ND	**ND**	ND	ND
3-Chlorothiophene	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Thiophenecarboxaldehyde	ND	ND	ND	ND	ND	**ND**	ND	ND
Naphthalene	3.525E-04	ND	7.151E-07	7.730E-07	3.506E-04	**2.858E-08**	5.565E-06	5.565E-06
Acetaldehyde	2.532E-04	ND	5.162E-07	5.580E-07	2.531E-04	**2.063E-08**	4.018E-06	4.018E-06
Acrolein	2.973E-04	ND	6.061E-07	6.552E-07	2.972E-04	**2.422E-08**	4.717E-06	4.717E-06
Acetone	6.416E-03	6.687E-03	2.139E-06	2.312E-06	1.049E-03	**8.547E-08**	1.664E-05	1.664E-05
Propanal	4.791E-04	4.046E-04	5.619E-07	6.074E-07	2.755E-04	**2.246E-08**	4.373E-06	4.373E-06
Furan	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Propanol	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methylpropanal	ND	ND	ND	ND	ND	**ND**	ND	ND
Methacrolein	ND	ND	ND	ND	ND	**ND**	ND	ND
2,3-Butanedione	ND	ND	ND	ND	ND	**ND**	ND	ND
Methyl-Vinyl Ketone	ND	ND	ND	ND	ND	**ND**	ND	ND
MTBE	7.509E-04	8.935E-04	6.191E-07	6.692E-07	3.035E-04	**2.474E-08**	4.818E-06	4.818E-06
Butanal	5.248E-04	7.080E-04	ND	ND	ND	**ND**	ND	ND
2-Butanone	9.181E-04	7.692E-04	6.199E-07	6.701E-07	3.040E-04	**2.477E-08**	4.825E-06	4.825E-06
Tetrahydrofuran	ND	1.814E-04	ND	ND	ND	**ND**	ND	ND
2-Methyl-1-propanol	ND	ND	ND	ND	ND	**ND**	ND	ND
trans-2-Butenal	ND	ND	ND	ND	ND	**ND**	ND	ND
Acetic Acid	3.053E-04	5.352E-04	ND	ND	ND	**ND**	ND	ND
2-Pentanone	1.668E-03	6.259E-04	2.121E-06	2.293E-06	1.040E-03	**8.478E-08**	1.651E-05	1.651E-05
Pentanal	7.479E-04	2.764E-03	ND	ND	ND	**ND**	ND	ND
4-Methyl-2-pentanone	ND	ND	ND	ND	ND	**ND**	ND	ND
trans-2-Pentenal	ND	ND	ND	ND	ND	**ND**	ND	ND
Cyclopentanone	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Hexanone	ND	ND	ND	ND	ND	**ND**	ND	ND
Hexanal	3.253E-04	8.135E-04	ND	ND	ND	**ND**	ND	ND
3-Furaldehyde	ND	ND	ND	ND	ND	**ND**	ND	ND
Butyl Acetate	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Furaldehyde	ND	2.690E-04	ND	ND	ND	**ND**	ND	ND
trans-2-Hexenal	ND	ND	ND	ND	ND	**ND**	ND	ND
1-Hexanol	ND	ND	ND	ND	ND	**ND**	ND	ND
3-Heptanone	3.454E-04	2.600E-04	4.398E-07	4.754E-07	2.156E-04	**1.758E-08**	3.423E-06	3.423E-06
2-Heptanone	ND	ND	ND	ND	ND	**ND**	ND	ND
Heptanal	3.369E-04	4.048E-04	2.752E-07	2.974E-07	1.349E-04	**1.100E-08**	2.142E-06	2.142E-06
trans-2-Heptenal	ND	ND	ND	ND	ND	**ND**	ND	ND
5-Methyl-2-furaldehyde	ND	ND	ND	ND	ND	**ND**	ND	ND
6-Methyl-2-heptanone	ND	ND	ND	ND	ND	**ND**	ND	ND
Benzaldehyde	1.856E-03	4.910E-04	2.782E-06	3.007E-06	1.364E-03	**1.112E-07**	2.165E-05	2.165E-05

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 1 Item ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/Item ER_1	* Event Pollutant Emission Rate 1 Item (g/sec) ER_{EV}
1-Heptanol	ND	ND	ND	ND	ND	**ND**	ND	ND
6-Methyl-5-hepten-2-one	ND	3.694E-04	ND	ND	ND	**ND**	ND	ND
2-Octanone	ND	ND	ND	ND	ND	**ND**	ND	ND
Octanal	8.664E-04	7.496E-04	1.003E-06	1.084E-06	4.917E-04	**4.007E-08**	7.804E-06	7.804E-06
Benzofuran	ND	ND	ND	ND	ND	**ND**	ND	ND
trans-2-Octenal	ND	ND	ND	ND	ND	**ND**	ND	ND
Acetophenone	5.289E-04	3.895E-04	2.829E-07	3.058E-07	1.387E-04	**1.131E-08**	2.202E-06	2.202E-06
2-Nonanone	ND	ND	ND	ND	ND	**ND**	ND	ND
Nonanal	1.128E-03	8.540E-04	5.578E-07	6.030E-07	2.735E-04	**2.229E-08**	4.341E-06	4.341E-06
trans-2-Nonenal	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Decanone	ND	ND	ND	ND	ND	**ND**	ND	ND
Decanal	ND	ND	ND	ND	ND	**ND**	ND	ND

Footnotes:

a: Items in bold represent duplicate values for those compounds that are common for Method TO-14 and TO-12.

Table B-3: Air Modeling Oupout Data for Semi-Volatile Organic Compounds

	Simulator Surface Trip Flare				Items per event (I)	1	item/event	
	NEW, lb = 1.08				release duration (t):	63	seconds	
	Number of Items = 1				Unit Concentration (UC):	5.135E-03	g/m³/(g/s)	
Compound	Measured Actual Concentration (mg/m³)	Measured Background Concentration (mg/m³)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 1 Item (grams/m³) CONC	Pollutant Emission Rate (g/sec)/Item ER_1	* Event Pollutant Emission Rate 1 Item (g/sec) ER_{EV}
Particulate/Vapor-phase SVOCs								
N-Nitrosodimethylamine	ND	ND	ND	ND	ND	**ND**	ND	ND
Pyridine	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Picoline	ND	ND	ND	ND	ND	**ND**	ND	ND
Methyl methanesulfonate	ND	ND	ND	ND	ND	**ND**	ND	ND
N-Nitrosomethylethylamine	ND	ND	ND	ND	ND	**ND**	ND	ND
N-Nitrosodiethylamine	ND	ND	ND	ND	ND	**ND**	ND	ND
Ethyl methanesulfonate	ND	ND	ND	ND	ND	**ND**	ND	ND
Phenol	ND	ND	ND	ND	ND	**ND**	ND	ND
Aniline	ND	ND	ND	ND	ND	**ND**	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND	ND	ND	**ND**	ND	ND
Pentachloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Benzyl alcohol	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
bis(2-Chloroisopropyl)ether	ND	ND	ND	ND	ND	**ND**	ND	ND
o-Toluidine	ND	ND	ND	ND	ND	**ND**	ND	ND
4-Methylphenol/3-Methylphenol	ND	ND	ND	ND	ND	**ND**	ND	ND
N-Nitroso-di-n-propylamine	ND	ND	ND	ND	ND	**ND**	ND	ND
Acetophenone	6.593E-04	1.852E-04	1.013E-06	1.095E-06	4.967E-04	**4.048E-08**	7.884E-06	7.884E-06
N-Nitrosomorpholine	ND	ND	ND	ND	ND	**ND**	ND	ND
N-Nitrosopyrrolidine	ND	ND	ND	ND	ND	**ND**	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
N-Nitrosopiperidine	ND	ND	ND	ND	ND	**ND**	ND	ND
Isophorone	ND	ND	ND	ND	ND	**ND**	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND	ND	ND	**ND**	ND	ND
Benzoic acid	ND	2.607E-03	ND	ND	ND	**ND**	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Naphthalene	2.396E-04	ND	5.058E-07	5.467E-07	2.480E-04	**2.021E-08**	3.936E-06	3.936E-06
p-Chloroaniline	ND	ND	ND	ND	ND	**ND**	ND	ND
2,6-Dichlorophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
Hexachloropropene	ND	ND	ND	ND	ND	**ND**	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	**ND**	ND	ND
Dimethylphenethylamine	ND	ND	ND	ND	ND	**ND**	ND	ND
N-Nitroso-di-n-butylamine	ND	ND	ND	ND	ND	**ND**	ND	ND

Tabel B-3: Air Modeling Oupout Data for Semi-Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	**Pollutant Concentration 1 Item ($grams/m^3$) CONC**	Pollutant Emission Rate (g/sec)/Item ER_1	* Event Pollutant Emission Rate 1 Item (g/sec) ER_{EV}
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	**ND**	ND	ND
Safrole	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2,4,5-Tetrachlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	**ND**	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
Isosafrole	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Nitroaniline	ND	ND	ND	ND	ND	**ND**	ND	ND
1,4-Naphthoquinone	ND	ND	ND	ND	ND	**ND**	ND	ND
Dimethylphthalate	ND	ND	ND	ND	ND	**ND**	ND	ND
1,3-Dinitrobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	**ND**	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	**ND**	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	**ND**	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	**ND**	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	**ND**	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	**ND**	ND	ND
Pentachlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
1-Naphthylamine	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Naphthylamine	ND	ND	ND	ND	ND	**ND**	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
Diethylphthalate	5.082E-04	ND	1.073E-06	1.160E-06	5.261E-04	**4.288E-08**	8.350E-06	8.350E-06
4-Chlorophenylphenyl ether	ND	ND	ND	ND	ND	**ND**	ND	ND
Fluorene	ND	ND	ND	ND	ND	**ND**	ND	ND
5-Nitro-o-toluidine	ND	ND	ND	ND	ND	**ND**	ND	ND
4-Nitroaniline	ND	ND	ND	ND	ND	**ND**	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	**ND**	ND	ND
Diphenylamine/N-NitrosoDPA	ND	ND	ND	ND	ND	**ND**	ND	ND
sym-Trinitrobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Diallate	ND	ND	ND	ND	ND	**ND**	ND	ND
Phenacetin	ND	ND	ND	ND	ND	**ND**	ND	ND
4-Bromophenylphenyl ether	ND	ND	ND	ND	ND	**ND**	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
4-Aminobiphenyl	ND	ND	ND	ND	ND	**ND**	ND	ND
Pronamide	ND	ND	ND	ND	ND	**ND**	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
Pentachloronitrobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	**ND**	ND	ND
Anthracene	ND	ND	ND	ND	ND	**ND**	ND	ND
Carbazole	ND	ND	ND	ND	ND	**ND**	ND	ND
Di-n-butylphthalate	1.061E-03	2.302E-04	1.791E-06	1.936E-06	8.780E-04	**7.157E-08**	1.394E-05	1.394E-05
4-Nitroquinoline-1-oxide	ND	ND	ND	ND	ND	**ND**	ND	ND
Methapyrilene	ND	ND	ND	ND	ND	**ND**	ND	ND

Table B-3: Air Modeling Oupout Data for Semi-Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	**Pollutant Concentration 1 Item ($grams/m^3$)** CONC	Pollutant Emission Rate (g/sec)/Item ER_1	* Event Pollutant Emission Rate 1 Item (g/sec) ER_{EV}
Fluoranthene	ND	ND	ND	ND	ND	**ND**	ND	ND
Benzidine	ND	ND	ND	ND	ND	**ND**	ND	ND
Pyrene	ND	ND	ND	ND	ND	**ND**	ND	ND
p-Dimethylaminoazobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	**ND**	ND	ND
Kepone	ND	ND	ND	ND	ND	**ND**	ND	ND
Butylbenzylphthalate	7.299E-04	6.346E-04	8.331E-07	9.006E-07	4.085E-04	**3.330E-08**	6.484E-06	6.484E-06
3,3'-Dimethylbenzidine	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Acetylaminofluorene	ND	ND	ND	ND	ND	**ND**	ND	ND
bis(2-Ethylhexyl)phthalate	8.618E-04	ND	1.846E-06	1.995E-06	9.049E-04	**7.376E-08**	1.436E-05	1.436E-05
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	**ND**	ND	ND
Benz(a)anthracene	ND	ND	ND	ND	ND	**ND**	ND	ND
Chrysene	ND	ND	ND	ND	ND	**ND**	ND	ND
Di-n-octylphthalate	4.235E-04	1.953E-04	4.934E-07	5.333E-07	2.419E-04	**1.972E-08**	3.840E-06	3.840E-06
7,12-Dimethylbenz(a)anthracene	ND	ND	ND	ND	ND	**ND**	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	**ND**	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	**ND**	ND	ND
Benz(a)pyrene	ND	ND	ND	ND	ND	**ND**	ND	ND
3-Methylcholanthrene	ND	ND	ND	ND	ND	**ND**	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	**ND**	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	**ND**	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	**ND**	ND	ND

Footnotes:
ND = Not Detected

APPENDIX C

HEALTH-BASED SCREENING LEVELS AND ACUTE TOXICITY VALUES

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
TSP	12789-66-1	5.00E+01		NA		5.00E+01	NA	NA		
PM_{10}		5.00E+01		NA		5.00E+01	NA	NA		
HCl	7647-01-0	2.08E+01	nc	2.08E+01	nc	2.08E+01	NA	7.14E+03	T	7.14E+03
Cl_2	7782-50-5	2.09E-01	nc	3.65E+02	nc	2.09E-01	2.89E+03	2.90E+03	E	2.89E+03
Dioxin TEQ	1746-01-6	4.48E-08	c	4.48E-08	c	4.48E-08	NA	3.50E+00	T	3.50E+00
Carbon Monoxide (CO)	630-08-0	1.57E+02		NA		1.57E+02	2.30E+05	2.28E+05	E	2.30E+05
Nitrogen Oxide (NOx)	10024-97-2	1.00E+02		NA		1.00E+02	NA	2.70E+05	T	2.70E+05
HCl (CEM System)	7647-01-0	2.08E+01	nc	2.08E+01	nc	2.08E+01	NA	7.14E+03	T	7.14E+03
Carbon Dioxide (CO_2)	124-38-9	NA		NA		NA	NA	5.40E+07	T	5.40E+07
Sulfur Dioxide (SO_2)	202-58-84	8.00E+01		NA		8.00E+01	7.89E+02	7.86E+02	E	7.89E+02
Aluminum	7429-90-5	NA		3.65E+00	nc	3.65E+00	NA	3.00E+04	T	3.00E+04
Antimony	7440-36-0	NA		1.46E+00	nc	1.46E+00	NA	1.50E+03	T	1.50E+03
Arsenic	7440-38-2	4.47E-04	c	4.15E-04	c	4.47E-04	NA	3.00E+01	T	3.00E+01
Barium	7440-39-3	5.21E-01	nc	5.11E-01	nc	5.21E-01	NA	1.50E+03	T	1.50E+03
Beryllium	7440-41-7	8.00E-04	c	7.45E-04	c	8.00E-04	NA	5.00E+00	T	5.00E+00
Cadmium	7440-43-9	1.07E-03	c	9.94E-04	c	1.07E-03	NA	3.00E+01	T	3.00E+01
Chromium	7440-43-9	NA	c	1.53E-04	c	1.53E-04	NA	1.50E+03	T	1.50E+03
Cobalt	7440-48-4	NA		2.20E+02	nc	2.20E+02	NA	6.00E+01	T	6.00E+01
Copper	7440-50-8	NA		1.46E+02	nc	1.46E+02	NA	3.00E+03	T	3.00E+03
Lead	7439-92-1	1.50E+00		NA		1.50E+00	NA	1.50E+02	T	1.50E+02
Magnesium	7439-95-4	NA		NA		NA	NA	3.00E+04	T	3.00E+04
Manganese	7439-96-5	5.11E-02	nc	5.22E-02	nc	5.11E-02	NA	3.00E+03	T	3.00E+03
Nickel	7440-02-0	NA		7.30E+01	nc	7.30E+01	NA	3.00E+03	T	3.00E+03
Phosphorus	7723-14-0	NA		NA		NA	NA	3.00E+02	T	3.00E+02
Selenium	7782-49-2	NA		1.83E+01	nc	1.83E+01	NA	6.00E+02	T	6.00E+02
Silver	7740-22-4	NA		1.83E+01	nc	1.83E+01	NA	3.00E+02	T	3.00E+02
Thallium	7440-28-0	NA		2.56E-01	nc	2.56E-01	NA	3.00E+02	T	3.00E+02
Zinc	7440-66-6	NA		1.10E+03	nc	1.10E+03	NA	3.00E+04	T	3.00E+04
Mercury	7439-97-6	3.13E-01	nc	3.14E-01	nc	3.13E-01	NA	1.00E+02	T	1.00E+02
TNMHC		NA		NA		NA	NA	NA		
Ethane	74-84-0	NA		NA		NA	NA	NA		
Ethylene	74-85-1	NA		NA		NA	NA	4.60E+05	T	4.60E+05
Acetylene	74-86-2	NA		NA		NA	NA	NA		
Propane	74-98-6	NA		NA		NA	NA	3.78E+06	T	3.78E+06
Propene	115-07-1	NA		NA		NA	NA	NA		
i-Butane	106-97-8	NA		NA		NA	NA	5.71E+06	T	5.71E+06

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
i-Butene	25167-67-3	NA		NA		NA	NA	NA		
1-Butene	106-98-9	NA		NA		NA	NA	NA		
1,3-Butadiene	106-99-0	3.74E-03	c	3.48E-03	c	3.74E-03	2.20E+04	2.21E+04	E	2.20E+04
n-Butane	106-97-8	NA		NA		NA	NA	5.71E+06	T	5.71E+06
trans-2-Butene	624-64-6	NA		NA		NA	NA	NA		
2,2-Dimethylpropane	463-82-1	NA		NA		NA	NA	NA		
cis-2-Butene	590-18-1	NA		NA		NA	NA	NA		
3-Methyl-1-butene	563-45-1	NA		NA		NA	NA	NA		
i-Pentane	109-66-0	NA		NA		NA	NA	1.80E+06	T	1.80E+06
1-Pentene	109-67-1	NA		NA		NA	NA	NA		
2-Methyl-1-butene	563-46-2	NA		NA		NA	NA	NA		
n-Pentane	109-66-0	NA		NA		NA	NA	1.80E+06	T	1.80E+06
Isoprene	78-79-5	NA		NA		NA	NA	NA		
trans-2-Pentene	646-04-8	NA		NA		NA	NA	NA		
cis-2-Pentene	627-20-3	NA		NA		NA	NA	NA		
2-Methyl-2-butene	513-35-9	NA		NA		NA	NA	NA		
2,2-Dimethylbutane	75-83-2	NA		NA		NA	NA	1.80E+06	T	1.80E+06
Cyclopentene	142-29-0	NA		NA		NA	NA	NA		
4-Methyl-1-pentene	691-37-2	NA		NA		NA	NA	NA		
Cyclopentane	287-92-3	NA		NA		NA	NA	NA		
2,3-Dimethylbutane	79-29-8	NA		NA		NA	NA	NA		
cis-4-Methyl-2-pentene	691-38-3	NA		NA		NA	NA	NA		
2-Methylpentane	107-83-5	NA		NA		NA	NA	1.80E+06	T	1.80E+06
3-Methylpentane	96-14-0	NA		NA		NA	NA	NA		
2-Methyl-1-pentene	763-29-1	NA		NA		NA	NA	NA		
1-Hexene	592-41-6	NA		NA		NA	NA	1.03E+05	T	1.03E+05
n-Hexane	110-54-3	2.10E+02	nc	2.1E+02	nc	2.10E+02	NA	5.28E+05	T	5.28E+05
trans-2-Hexene	4050-45-7	NA		NA		NA	NA	NA		
2-Methyl-2-pentene	625-27-4	NA		NA		NA	NA	NA		
cis-2-Hexene	7688-21-3	NA		NA		NA	NA	NA		
Methylcyclopentane	96-37-7	NA		NA		NA	NA	NA		
2,4-Dimethylpentane	108-08-7	NA		NA		NA	NA	NA		
Benzene	71-43-2	2.50E-01	c	2.2E-01	c	2.50E-01	1.56E+05	1.60E+05	E	1.56E+05
Cyclohexane	110-82-7	NA		NA		NA	NA	3.10E+06	T	3.10E+06
2-Methylhexane	591-76-4	NA		NA		NA	NA	NA		
2,3-Dimethylpentane	565-59-3	NA		NA		NA	NA	NA		

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
3-Methylhexane	589-34-4	NA		NA		NA	NA	NA		
2,2,4-Trimethylpentane	540-84-1	NA		NA		NA	NA	3.50E+05	T	3.50E+05
n-Heptane	142-82-5	NA		NA		NA	NA	1.80E+06	T	1.80E+06
2,4,4-Trimethyl-1-pentene	107-39-1	NA		NA		NA	NA	NA		
Methylcyclohexane	108-87-2	3.10E+03	nc	3.1E+03	nc	3.10E+03	NA	4.81E+06	T	4.81E+06
2,4,4-Trimethyl-2-pentene	107-40-4	NA		NA		NA	NA	NA		
2,5-Dimethylhexane	592-13-2	NA		NA		NA	NA	NA		
2,4-Dimethylhexane	589-43-5	NA		NA		NA	NA	NA		
2,3,4-Trimethylpentane	565-59-3	NA		NA		NA	NA	NA		
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc	4.02E+02	1.88E+05	1.89E+05	E	1.88E+05
2,3-Dimethylhexane	584-94-1	NA		NA		NA	NA	NA		
2-Methylheptane	592-27-8	NA		NA		NA	NA	NA		
3-Ethylhexane	619-99-8	NA		NA		NA	NA	NA		
2,2-Dimethylheptane	1071-26-7	NA		NA		NA	NA	NA		
2,2,4-Trimethylhexane	16747-26-5	NA		NA		NA	NA	NA		
n-Octane	111-65-9	NA		NA		NA	NA	NA		
Ethylcyclohexane	1678-91-7	NA		NA		NA	NA	NA		
Ethylbenzene	100-41-4	1.10E+03	nc	1.1E+03	nc	1.10E+03	NA	5.43E+05	T	5.43E+05
m-Xylene & p-Xylene	108-38-3	NA		NA		NA	NA	6.51E+05	T	6.51E+05
Styrene	100-42-5	1.10E+03	nc	1.0E+03	nc	1.10E+03	2.13E+05	2.13E+05	E	2.13E+05
o-Xylene	95-47-6	NA		7.3E+03	nc	7.30E+03	NA	6.51E+05	T	6.51E+05
n-Nonane	111-84-2	NA		4.0E+02	nc	4.02E+02	NA	1.05E+06	T	1.05E+06
i-Propylbenzene	98-82-8	4.00E+02	nc	4.0E+02	nc	4.00E+02	NA	NA		
n-Propylbenzene	103-65-1	3.65E+01	nc	1.5E+02	nc	3.65E+01	NA	NA		
p-Ethyltoluene	622-96-8	NA		NA		NA	NA	1.25E+05	T	1.25E+05
m-Ethyltoluene	620-14-4	NA		NA		NA	NA	NA		
1,3,5-Trimethylbenzene	108-67-8	6.20E+00	nc	6.2E+00	nc	6.20E+00	NA	3.68E+05	T	3.68E+05
o-Ethyltoluene	611-14-3	NA		NA		NA	NA	7.50E+02	T	7.50E+02
1,2,4-Trimethylbenzene & sec-Butylbenzene	95-63-6	6.21E+00	nc	6.21E+00	nc	6.21E+00	NA	1.80E+05	T	1.80E+05
n-Decane	124-18-5	NA		NA		NA	NA	4.37E+03	T	4.37E+03
alpha-Pinene	80-56-8	NA		NA		NA	NA	4.00E+04	T	4.00E+04
beta-Pinene	127-91-3	NA		NA		NA	NA	NA		
delta 3-Carene	13466-78-9	NA		NA		NA	NA	NA		
d-Limonene	5989-27-5	NA		NA		NA	NA	1.95E+06	T	1.95E+06
MTBE	1634-04-4	3.10E+03	nc	3.1E+03	nc	3.10E+03	NA	4.32E+05	T	4.32E+05
Dichlorodifluoromethane	75-71-8	2.10E+02	nc	1.8E+02	nc	2.10E+02	NA	1.48E+07	T	1.48E+07

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
Methylchloride	74-87-33	NA		NA		NA	NA	NA		
Dichlorotetrafluoroethane	374-07-2	NA		NA		NA	NA	NA		
Chloroethene	75-01-4	2.20E-02	c	2.1E-02	c	2.20E-02	NA	1.28E+04	T	1.28E+04
1,3-Butadiene	106-99-0	3.74E-03	c	3.48E-03	c	3.74E-03	2.20E+04	2.21E+04	E	2.20E+04
Methylbromide	74-83-9	5.20E+00	nc	5.1E+00	nc	5.20E+00	NA	5.82E+04	T	5.82E+04
Ethylchloride	75-00-3	2.30E+00	c	2.2E+00	c	2.30E+00	NA	7.92E+06	T	7.92E+06
Trichloromonofluoromethane	75-69-4	7.30E+02	nc	7.30E+02	nc	7.30E+02	NA	2.81E+06	T	2.81E+06
Vinylidene chloride	75-35-4	NA		NA		NA	NA	7.92E+04	T	7.92E+04
Methylene chloride	75-09-2	4.10E+00	c	3.8E+00	c	4.10E+00	6.96E+05	6.94E+05	E	6.96E+05
Allyl chloride	107-05-1	1.00E+00	nc	NA		1.00E+00	9.39E+03	9.39E+03	E	9.39E+03
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	3.13E+04	nc	3.14E+04	nc	3.13E+04	NA	9.58E+06	T	9.58E+06
1,1-Dichloroethane	75-34-3	5.21E+02	nc	5.11E+02	nc	5.21E+02	NA	1.21E+06	T	1.21E+06
1,2-Dichloroethene	540-59-0	NA		3.29E+01	nc	3.29E+01	NA	2.38E+06	T	2.38E+06
Chloroform	67-66-3	8.40E-02	c	2.2E+00	c	8.40E-02	NA	9.76E+03	T	9.76E+03
1,2-Dichloroethane	107-06-2	7.39E-02	c	6.88E-02	c	7.39E-02	NA	8.08E+03	T	8.08E+03
Methylchloroform	71-55-6	1.00E+03	nc	2.3E+03	nc	1.00E+03	NA	1.91E+06	T	1.91E+06
Benzene	71-43-2	2.50E-01	c	2.2E-01	c	2.50E-01	NA	1.60E+05	T	1.60E+05
Carbontetrachloride	56-23-5	1.04E+03	nc	1.04E+03	nc	1.04E+03	1.28E+05	1.26E+05	E	1.28E+05
1,2-Dichloropropane	78-87-5	9.89E-02	c	9.21E-02	c	9.89E-02	NA	5.08E+05	T	5.08E+05
Trichloroethylene	79-01-6	1.12E+00	c	1.04E+00	c	1.12E+00	NA	5.37E+05	T	5.37E+05
cis 1,3-Dichloro-1-propene	10061-01-5	NA		NA		NA	NA	1.14E+04	T	1.14E+04
trans 1,3-Dichloro-1-propene	10061-02-6	NA		NA		NA	NA	NA		
1,1,2-Trichloroethane	79-00-5	1.20E-01	c	1.12E-01	c	1.20E-01	NA	1.64E+05	T	1.64E+05
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc	4.02E+02	1.88E+05	1.89E+05	E	1.88E+05
1,2-Dibromoethane	106-93-4	8.73E-03	c	8.24E-03	c	8.73E-03	NA	1.54E+05	T	1.54E+05
Perchloroethylene	127-18-4	3.31E+00	c	3.13E+00	c	3.31E+00	6.89E+05	6.78E+05	E	6.89E+05
Chlorobenzene	108-90-7	6.20E+01	nc	6.2E+01	nc	6.20E+01	NA	1.38E+05	T	1.38E+05
Ethylbenzene	100-41-4	1.10E+03	nc	1.1E+03	nc	1.10E+03	NA	4.34E+03	T	4.34E+03
m&p-Xylene	108-38-3	7.30E+02	nc	NA		7.30E+02	NA	6.51E+05	T	6.51E+05
Styrene	100-42-5	1.06E+03	nc	1.04E+03	nc	1.06E+03	2.13E+05	2.13E+05	E	2.13E+05
1,1,2,2-Tetrachloroethane	79-34-5	3.31E-02	c	3.13E-02	c	3.31E-02	NA	2.06E+04	T	2.06E+04
o-Xylene	95-47-6	7.30E+02	nc	7.3E+03	nc	7.30E+02	NA	6.51E+05	T	6.51E+05
p-Ethyltoluene	622-96-8	NA		NA		NA	NA	1.25E+05	T	1.25E+05
1,3,5-Trimethylbenzene	108-67-8	6.21E+00	nc	6.21E+00	nc	6.21E+00	NA	3.68E+05	T	3.68E+05
1,2,4-Trimethylbenzene	95-63-6	6.21E+00	nc	6.21E+00	nc	6.21E+00	NA	1.80E+05	T	1.80E+05
Benzylchloride	100-44-7	4.00E-02	nc	3.7E-02	c	4.00E-02	5.20E+03	5.17E+03	E	5.20E+03

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
m-Dichlorobenzene	541-73-1	3.30E+00	nc	3.3E+00	nc	3.30E+00	NA	3.61E+04	T	3.61E+04
p-Dichlorobenzene	106-46-7	2.80E-01	c	2.85E-01	c	2.80E-01	NA	6.61E+05	T	6.61E+05
o-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02	NA	3.01E+05	T	3.01E+05
1,2,4-Trichlorobenzene	120-82-1	NA		NA		NA	NA	3.71E+04	T	3.71E+04
Hexachlorobutadiene	87-68-3	8.73E-02	c	8.03E-02	c	8.73E-02	3.21E+04	3.20E+04	E	3.21E+04
trans-1,2-Dichloroethene	156-60-5	7.30E+01	nc	7.3E+01	nc	7.30E+01	NA	4.95E+04	T	4.95E+04
o-Chlorotoluene	95-49-8	7.30E+01	nc	7.3E+01	nc	7.30E+01	NA	3.88E+05	T	3.88E+05
p-Chlorotoluene	106-43-4	NA		NA		NA	NA	3.88E+05	T	3.88E+05
1,3,5-Trichlorobenzene	108-70-3	NA		NA		NA	NA	NA		
1,2,3-Trichlorobenzene	87-61-6	NA		NA		NA	NA	5.00E+04	T	5.00E+04
Methylnitrite	624-91-9	NA		NA		NA	NA	NA		
Acetonitrile	75-05-8	6.20E+01	nc	6.2E+01	nc	6.20E+01	NA	1.01E+05	T	1.01E+05
Acrylonitrile	107-13-1	2.80E-02	c	2.6E-02	c	2.80E-02	2.20E+04	2.17E+04	E	2.20E+04
Nitromethane	75-52-5	NA		NA		NA	NA	1.50E+05	T	1.50E+05
Benzonitrile	100-47-0	NA		NA		NA	NA	1.50E+04	T	1.50E+04
Nitrobenzene	98-95-3	2.09E+00	nc	2.19E+00	nc	2.09E+00	NA	1.51E+04	T	1.51E+04
Carbonyl Sulfide	463-58-1	NA		NA		NA	NA	9.84E+03	T	9.84E+03
Sulfur Dioxide	7446-09-5	NA		NA		NA	7.80E+02	7.86E+02	E	7.80E+02
Carbon Disulfide	75-15-0	7.30E+02	nc	7.3E+02	nc	7.30E+02	NA	3.73E+04	T	3.73E+04
Thiophene	110-02-1	NA		NA		NA	NA	NA		
Dimethyldisulfide	624-92-0	NA		NA		NA	4.00E+01	3.85E+01	E	4.00E+01
2-Methylthiophene	554-14-3	NA		NA		NA	NA	NA		
3-Methylthiophene	616-44-4	NA		NA		NA	NA	NA		
Dimethyltrisulfide	3658-80-8	NA		NA		NA	NA	NA		
Isothiocyanatomethane	556-61-6	NA		NA		NA	NA	NA		
2-Chlorothiophene	96-43-5	NA		NA		NA	NA	NA		
3-Chlorothiophene	17249-80-8	NA		NA		NA	NA	NA		
2-Thiophenecarboxaldehyde	98-03-3	NA		NA		NA	NA	NA		
Naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc	3.13E+00	NA	7.86E+04	T	7.86E+04
Acetaldehyde	75-07-0	8.70E-01	c	8.1E-01	c	8.70E-01	1.80E+04	1.80E+04	E	1.80E+04
Acrolein	107-02-8	2.10E-02	nc	2.1E-02	nc	2.10E-02	2.30E+02	2.29E+03	E	2.30E+02
Acetone	67-64-1	3.40E+02	nc	3.7E+02	nc	3.40E+02	NA	2.37E+06	T	2.37E+06
Propanal	123-38-6	NA		NA		NA	NA	7.50E+04	T	7.50E+04
Furan	110-00-9	3.70E+00	nc	NA		3.70E+00	NA	1.67E+02	T	1.67E+02
2-Propanol	67-63-0	NA		NA		NA	NA	9.84E+05	T	9.84E+05
2-Methylpropanal	78-84-2	NA		NA		NA	NA	NA		

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
Methacrolein	78-85-3	NA		NA		NA	NA	NA		
2,3-Butanedione	625-34-3	NA		NA		NA	NA	NA		
Methyl-Vinyl Ketone	78-94-4	NA		NA		NA	NA	8.61E+01	T	8.61E+01
MTBE	1634-04-4	3.10E+03	nc	3.1E+03	nc	3.10E+03	NA	4.32E+05	T	4.32E+05
Butanal	123-72-8	NA		NA		NA	NA	7.38E+04	T	7.38E+04
2-Butanone	78-93-3	1.00E+03	nc	1.0E+03	nc	1.00E+03	NA	8.85E+05	T	8.85E+05
Tetrahydrofuran	109-99-9	9.89E-01	nc	9.21E-01	c	9.89E-01	NA	7.38E+05	T	7.38E+05
2-Methyl-1-propanol	78-83-1	1.10E+03	nc	1.1E+03	nc	1.10E+03	NA	4.55E+05	T	4.55E+05
trans-2-Butenal	123-73-9	3.54E-03	c	3.30E-03	c	3.54E-03	NA	NA		
Acetic Acid	64-19-7	NA		NA		NA	NA	3.68E+04	T	3.68E+04
2-Pentanone	107-87-9	NA		NA		NA	NA	8.80E+05	T	8.80E+05
Pentanal	110-62-3	NA		NA		NA	NA	NA		
4-Methyl-2-pentanone	108-10-1	8.30E+01	nc	7.3E+01	nc	8.30E+01	NA	3.07E+05	T	3.07E+05
trans-2-Pentenal	1567-87-0	NA		NA		NA	NA	NA		
Cyclopentanone	120-92-3	NA		NA		NA	NA	NA		
2-Hexanone	591-78-6	NA		5.1E+00	nc	5.11E+00	NA	4.09E+04	T	4.09E+04
Hexanal	66-25-1	NA		NA		NA	NA	NA		
3-Furaldehyde	498-60-2	NA		NA		NA	NA	NA		
Butyl Acetate	123-86-4	NA		NA		NA	NA	NA		
2-Furaldehyde	98-01-1	5.20E+01	nc	3.7E+01	nc	5.20E+01	NA	7.86E+03	T	7.86E+03
trans-2-Hexenal	6728-26-3	NA		NA		NA	NA	NA		
1-Hexanol	111-27-3	NA		NA		NA	NA	8.36E+03	T	8.36E+03
3-Heptanone	106-35-4	NA		NA		NA	NA	NA		
2-Heptanone	110-43-0	NA		NA		NA	NA	1.70E+03	T	1.70E+03
Heptanal	66-25-1	NA		NA		NA	NA	NA		
trans-2-Heptenal	18829-55-5	NA		NA		NA	NA	NA		
5-Methyl-2-furaldehyde	620-02-0	NA		NA		NA	NA	NA		
6-Methyl-2-heptanone	928-68-7	NA		NA		NA	NA	NA		
Benzaldehyde	100-52-7	3.70E+02	nc	3.7E+02	nc	3.70E+02	NA	1.50E+04	T	1.50E+04
1-Heptanol	111-70-6	NA		NA		NA	NA	NA		
6-Methyl-5-hepten-2-one	110-93-0	NA		NA		NA	NA	NA		
2-Octanone	111-13-7	NA		NA		NA	NA	NA		
Octanal	124-13-0	NA		NA		NA	NA	NA		
Benzofuran	271-89-6	NA		NA		NA	NA	NA		
trans-2-Octenal	2548-87-0	NA		NA		NA	NA	NA		
Acetophenone	98-86-2	2.10E-02	nc	2.1E-02	nc	2.10E-02	NA	3.00E+04	T	3.00E+04

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
2-Nonanone	821-55-6	NA		NA		NA	NA	NA		
Nonanal	124-19-6	NA		NA		NA	NA	NA		
trans-2-Nonenal	18829-56-6	NA		NA		NA	NA	NA		
2-Decanone	693-54-9	NA		NA		NA	NA	NA		
Decanal	112-31-2	NA		NA		NA	NA	NA		
N-Nitrosodimethylamine	62-75-9	1.40E-04	c	1.2E-04	c	1.40E-04	NA	2.50E+03	T	2.50E+03
Pyridine	110-86-1	3.65E+00	nc	3.65E+00	nc	3.65E+00	NA	4.85E+04	T	4.85E+04
2-Picoline	109-06-8	NA		NA		NA	NA	NA		
Methyl methanesulfonate	66-27-3	NA		NA		NA	NA	NA		
N-Nitrosomethylethylamine	10595-95-6	3.06E-04	c	2.85E-04	c	3.06E-04	NA	NA		
N-Nitrosodiethylamine	55-18-5	4.47E-05	c	4.17E-05	c	4.47E-05	NA	NA		
Ethyl methanesulfonate	62-50-0	NA		NA		NA	NA	NA		
Phenol	108-95-2	2.19E+03	nc	2.19E+03	nc	2.19E+03	3.85E+05	3.85E+04	E	3.85E+05
Aniline	62-53-3	NA		1.1E+00	nc	1.06E+00	NA	2.29E+04	T	2.29E+04
bis(2-Chloroethyl)ether	111-44-4	5.80E-03	c	5.7E-03	c	5.80E-03	NA	5.85E+04	T	5.85E+04
Pentachloroethane	76-01-7	NA		NA		NA	NA	NA		
2-Chlorophenol	95-57-8	1.80E+01	nc	1.8E+01	nc	1.80E+01	NA	5.25E+03	T	5.25E+03
1,3-Dichlorobenzene	543-73-1	NA		NA		NA	NA	NA		
1,4-Dichlorobenzene	106-46-7	2.80E-01	c	2.85E-01	c	2.80E-01	NA	6.61E+05	T	6.61E+05
Benzyl alcohol	100-51-6	1.10E+03	nc	1.1E+03	nc	1.10E+03	NA	5.53E+04	T	5.53E+04
2-Methylphenol	95-48-7	NA		NA		NA	NA	6.63E+04	T	6.63E+04
1,2-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02	NA	3.01E+05	T	3.01E+05
bis(2-Chloroisopropyl)ether	108-60-1	1.92E-01	c	1.79E-01	c	1.92E-01	NA	6.99E+04	T	6.99E+04
o-Toluidine	95-53-4	2.80E-02	c	2.6E-02	c	2.80E-02	NA	2.63E+04	T	2.63E+04
4-Methylphenol/3-Methylphenol	1319-77-3	NA		NA		NA	NA	6.63E+04	T	6.63E+04
N-Nitroso-di-n-propylamine	621-64-7	9.61E-04	c	8.94E-04	c	9.61E-04	NA	5.32E+03	T	5.32E+03
Acetophenone	98-86-2	2.10E-02	nc	2.1E-02	nc	2.10E-02	NA	1.47E+05	T	1.47E+05
N-Nitrosomorpholine	59-89-2	NA		NA		NA	NA	3.00E+04	T	3.00E+04
N-Nitrosopyrrolidine	930-55-2	3.15E-03	c	3.0E-03	c	3.15E-03	NA	NA		
Hexachloroethane	67-72-1	4.80E-01	c	4.47E-01	c	4.80E-01	NA	2.90E+04	T	2.90E+04
Nitrobenzene	98-95-3	2.09E+00	nc	2.19E+00	nc	2.09E+00	NA	1.51E+04	T	1.51E+04
N-Nitrosopiperidine	100-75-4	NA		NA		NA	NA	NA		
Isophorone	78-59-1	7.08E+00	c	6.59E+00	c	7.08E+00	NA	2.83E+04	T	2.83E+04
2,4-Dimethylphenol	105-67-9	7.30E+01	nc	7.3E+01	nc	7.30E+01	NA	NA		
2-Nitrophenol	88-75-5	NA		NA		NA	NA	NA		
bis(2-Chloroethoxy)methane	111-91-1	NA		NA		NA	NA	NA		

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
Benzoic acid	65-85-0	1.50E+04	nc	1.5E+04	nc	1.50E+04	NA	1.25E+04	T	1.25E+04
2,4-Dichlorophenol	120-83-2	1.10E+01	nc	1.1E+01	nc	1.10E+01	NA	3.00E+04	T	3.00E+04
1,2,4-Trichlorobenzene	120-82-1	NA		NA		NA	NA	3.71E+04	T	3.71E+04
Naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc	3.13E+00	NA	7.86E+04	T	7.86E+04
p-Chloroaniline	106-47-8	1.46E+01	nc	1.46E+01	nc	1.46E+01	NA	5.21E+03	T	5.21E+03
2,6-Dichlorophenol	87-65-0	NA		NA		NA	NA	3.00E+04	T	3.00E+04
Hexachloropropene	1888-71-7	NA		NA		NA	NA	NA		
Hexachlorobutadiene	87-68-3	8.73E-02	c	8.03E-02	c	8.73E-02	3.21E+04	3.20E+04	E	3.21E+04
Dimethylphenethylamine		NA		NA		NA	NA	NA		
N-Nitroso-di-n-butylamine	924-16-3	1.20E-03	c	1.12E-03	c	1.20E-03	NA	NA		
4-Chloro-3-methylphenol	35421-08-0	NA		NA		NA	NA	NA		
Safrole	94-59-7	NA		NA		NA	NA	NA		
2-Methylnaphthalene	91-57-6	NA		NA		NA	NA	2.00E+04	T	2.00E+04
1,2,4,5-Tetrachlorobenzene	95-94-3	1.10E+00	nc	1.10E+00	nc	1.10E+00	NA	3.00E+04	T	3.00E+04
Hexachlorocyclopentadiene	77-47-4	7.30E-02	nc	7.30E-02	nc	7.30E-02	NA	2.23E+02	T	2.23E+02
2,4,6-Trichlorophenol	88-06-2	6.20E-01	c	6.3E-01	c	6.20E-01	NA	3.00E+04	T	3.00E+04
2,4,5-Trichlorophenol	95-95-4	3.70E+02	nc	3.7E+02	nc	3.70E+02	NA	3.00E+04	T	3.00E+04
Isosafrole	120-58-1	NA		NA		NA	NA	NA		
2-Chloronaphthalene	91-58-7	2.90E+02	nc	2.9E+02	nc	2.90E+02	NA	6.00E+02	T	6.00E+02
2-Nitroaniline	88-74-4	2.10E-01	nc	2.1E-01	nc	2.10E-01	NA	NA		
1,4-Naphthoquinone	130-15-4	NA		NA		NA	NA	2.50E+02	T	2.50E+02
Dimethylphthalate	131-11-3	3.65E+04	nc	3.65E+04	nc	3.65E+04	NA	1.50E+04	T	1.50E+04
1,3-Dinitrobenzene	99-65-0	3.70E-01	nc	3.7E-01	nc	3.70E-01	NA	3.00E+03	T	3.00E+03
2,6-Dinitrotoluene	606-20-2	3.70E+00	nc	3.7E+00	nc	3.70E+00	NA	6.00E+02	T	6.00E+02
Acenaphthylene	208-96-8	NA		NA		NA	NA	2.00E+02	T	2.00E+02
3-Nitroaniline	99-09-2	NA		NA		NA	NA	NA		
4-Nitrophenol	100-02-7	2.90E+01	nc	2.9E+01	nc	2.90E+01	NA	3.00E+04	T	3.00E+04
2,4-Dinitrophenol	51-28-5	7.30E+00	nc	7.3E+00	nc	7.30E+00	NA	7.50E+03	T	7.50E+03
Acenaphthene	83-32-9	2.20E+02	nc	2.2E+02	nc	2.20E+02	NA	1.25E+03	T	1.25E+03
2,4-Dinitrotoluene	121-14-2	7.30E+00	nc	7.3E+00	nc	7.30E+00	NA	6.00E+02	T	6.00E+02
Dibenzofuran	132-64-9	1.46E+01	nc	1.46E+01	nc	1.46E+01	NA	1.50E+00	T	1.50E+00
Pentachlorobenzene	608-93-5	2.92E+00	nc	2.92E+00	nc	2.92E+00	NA	3.00E+04	T	3.00E+04
1-Naphthylamine	134-32-7	NA		NA		NA	NA	3.50E+04	T	3.50E+04
2-Naphthylamine	91-59-8	NA		NA		NA	NA	7.50E+03	T	7.50E+03
2,3,4,6-Tetrachlorophenol	58-90-2	1.10E+02	nc	1.1E+02	nc	1.10E+02	NA	NA		
Diethylphthalate	84-66-2	2.92E+03	nc	2.92E+03	nc	2.92E+03	NA	1.50E+04	T	1.50E+04

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	**CAS #**	**Region 9 PRG ($\mu g/m^3$)**	**Toxicity Endpoint (c or nc)**	**Region 3 RBC ($\mu g/m^3$)**	**Toxicity Endpoint (c or nc)**	**Health-based Screening Level ($\mu g/m^3$)**	**ERPG ($\mu g/m^3$)**	**TEEL ($\mu g/m^3$)**	**Source (T or E)**	**Acute Toxicity Value ($\mu g/m^3$)**
4-Chlorophenylphenyl ether	7005-72-3	NA		NA		NA	NA	NA		
Fluorene	86-73-7	1.46E+02	nc	1.46E+02	nc	1.46E+02	NA	7.50E+04	T	7.50E+04
5-Nitro-o-toluidine	99-55-8	2.00E-01	c	1.9E-01	c	2.00E-01	NA	NA		
4-Nitroaniline	100-01-6	NA		NA		NA	NA	9.00E+03	T	9.00E+03
4,6-Dinitro-2-methylphenol	534-52-1	NA		3.7E-01	nc	3.65E-01	NA	5.00E+02	T	5.00E+02
Diphenylamine/N-NitrosoDPA	62-75-9	NA		NA		NA	NA	2.50E+03	T	2.50E+03
sym-Trinitrobenzene	99-35-4	1.10E+02	nc	1.10E+02	nc	1.10E+02	NA	3.00E+04	T	3.00E+04
Diallate	2303-16-4	1.10E-01	c	NA		1.10E-01	NA	NA		
Phenacetin	62-44-2	NA		NA		NA	NA	3.00E+04	T	3.00E+04
4-Bromophenylphenyl ether	101-55-3	NA		NA		NA	NA	NA		
Hexachlorobenzene	118-74-1	4.18E-03	c	3.91E-03	c	4.18E-03	NA	7.50E+01	T	7.50E+01
4-Aminobiphenyl	92-67-1	NA		NA		NA	NA	1.50E+03	T	1.50E+03
Pronamide	23950-58-5	2.74E+02	nc	NA		2.74E+02	NA	NA		
Pentachlorophenol	87-86-5	5.60E-02	c	5.22E-02	c	5.60E-02	NA	1.50E+03	T	1.50E+03
Pentachloronitrobenzene	82-68-8	2.59E-02	c	2.41E-02	c	2.59E-02	NA	1.50E+03	T	1.50E+03
Phenanthrene	85-01-8	NA		NA		NA	NA	2.00E+03	T	2.00E+03
Anthracene	120-12-7	1.10E+03	nc	1.1E+03	nc	1.10E+03	NA	6.00E+03	T	6.00E+03
Carbazole	86-74-8	3.36E-01	c	3.13E-01	c	3.36E-01	NA	NA		
Di-n-butylphthalate	84-74-2	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	1.50E+04	T	1.50E+04
4-Nitroquinoline-1-oxide	56-57-5	NA		NA		NA	NA	NA		
Methapyrilene	91-80-5	NA		NA		NA	NA	NA		
Fluoranthene	206-44-0	1.50E+02	nc	1.5E+02	nc	1.50E+02	NA	3.00E+01	T	3.00E+01
Benzidine	92-87-5	2.90E-05	c	NA		2.90E-05	NA	5.00E+02	T	5.00E+02
Pyrene	129-00-0	NA		NA		NA	NA	1.50E+04	T	1.50E+04
p-Dimethylaminoazobenzene	60-11-7	NA		NA		NA	NA	7.50E+04	T	7.50E+04
Chlorobenzilate	510-15-6	2.49E-02	c	2.32E-02	c	2.49E-02	NA	2.50E+02	T	2.50E+02
Kepone	143-50-0	3.74E-04	c	NA		3.74E-04	NA	1.00E+02	T	1.00E+02
Butylbenzylphthalate	85-68-7	7.30E+02	nc	7.30E+02	nc	7.30E+02	NA	5.00E+05	T	5.00E+05
3,3'-Dimethylbenzidine	119-93-7	7.30E-04	c	6.8E-04	c	7.30E-04	NA	3.00E+00	T	3.00E+00
2-Acetylaminofluorene	53-96-3	NA		NA		NA	NA	2.50E+03	T	2.50E+03
bis(2-Ethylhexyl)phthalate	117-81-7	4.80E-01	c	4.47E-01	c	4.80E-01	NA	1.00E+04	T	1.00E+04
3,3'-Dichlorobenzidine	91-94-1	1.50E-02	c	1.4E-02	c	1.50E-02	NA	6.21E+03	T	6.21E+03
Benz(a)anthracene	56-55-3	2.20E-02	c	8.6E-03	c	2.20E-02	NA	6.00E+02	T	6.00E+02
Chrysene	218-01-9	2.17E+00	c	8.58E-01	c	2.17E+00	NA	2.00E+02	T	2.00E+02
Di-n-octylphthalate	117-84-0	7.30E+01	nc	7.30E+01	nc	7.30E+01	NA	1.50E+05	T	1.50E+05
7,12-Dimethylbenz(a)anthracene	57-97-6	NA		NA		NA	NA	NA		

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	**CAS #**	**Region 9 PRG ($\mu g/m^3$)**	**Toxicity Endpoint (c or nc)**	**Region 3 RBC ($\mu g/m^3$)**	**Toxicity Endpoint (c or nc)**	**Health-based Screening Level ($\mu g/m^3$)**	**ERPG ($\mu g/m^3$)**	**TEEL ($\mu g/m^3$)**	**Source (T or E)**	**Acute Toxicity Value ($\mu g/m^3$)**
Benzo(b)fluoranthene	205-99-2	2.20E-02	c	8.6E-03	c	2.20E-02	NA	NA		
Benzo(k)fluoranthene	207-08-9	2.20E-01	c	8.6E-02	c	2.20E-01	NA	NA		
Benz(a)pyrene	50-32-8	2.20E-03	c	2.0E-03	c	2.20E-03	NA	7.50E+03	T	7.50E+03
3-Methylcholanthrene	56-49-5	NA		NA		NA	NA	1.50E+03	T	1.50E+03
Indeno(1,2,3-cd)pyrene	193-39-5	2.17E-02	c	8.58E-03	c	2.17E-02	NA	NA		
Dibenz(a,h)anthracene	53-70-3	2.17E-03	c	8.58E-04	c	2.17E-03	NA	3.00E+04	T	3.00E+04
Benzo(g,h,i)perylene	191-24-2	NA		NA		NA	NA	3.00E+04	T	3.00E+04

Footnotes:
PRG: Preliminary Remediation Goals
c: Cancer
nc:non-cancer
RBC: Risk-Based Concentration
HBSL: Health-based Screening Level
(E) ERPG: Emergency Response Planning Guidelines
(T) TEEL: Temporary Emergency Exposure Limits
ATV: Acute Toxicity Value
NA: Not available

APPENDIX D

RISK EVALUATION DATA

Table D-1: Comparison of Air Concentrations With Health-Based Values: Metals, Particulates and Miscellaneous Compounds

	Simulator Surface Trip Flare							
Compound	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
TSP	3.54E+00	5.00E+01	7.08E-02	no	NA	NA		na
PM_{10}	1.70E+00	5.00E+01	3.40E-02	no	NA	NA		na
HCl (a)	1.32E-04	2.08E+01	6.34E-06	no	2.78E-01	7.14E+03	3.89E-05	no
Cl_2 (a)	4.89E-04	2.09E-01	2.35E-03	no	2.57E-01	2.89E+03	8.90E-05	no
Dioxin TEQ (b)	2.43E-12	4.48E-08	5.43E-05	no	1.19E-08	3.50E+00	3.41E-09	no
Carbon Monoxide (CO)	1.10E-02	1.57E+02	6.98E-05	no	5.76E+00	2.30E+05	2.50E-05	no
Nitrogen Oxide (NOx)	5.84E-02	1.00E+02	5.84E-04	no	1.23E+02	2.70E+05	4.55E-04	no
HCl (a)	NA	2.08E+01		na	NA	7.14E+03		na
Carbon Dioxide (CO_2)	1.05E+00	NV		na	2.21E+03	5.40E+07	4.10E-05	no
Sulfur Dioxide (SO_2)	1.97E-03	8.00E+01	2.47E-05	no	1.04E+00	7.89E+02	1.31E-03	no
Aluminum	5.25E-04	3.65E+00	1.44E-04	no	1.10E+00	3.00E+04	3.68E-05	no
Antimony	2.25E-05	1.46E+00	1.54E-05	no	4.74E-02	1.50E+03	3.16E-05	no
Arsenic	NA	4.47E-04		na	NA	3.00E+01		na
Barium	2.01E-03	5.21E-01	3.86E-03	no	4.23E+00	1.50E+03	2.82E-03	no
Beryllium	NA	8.00E-04		na	NA	5.00E+00		na
Cadmium	2.10E-06	1.07E-03	1.97E-03	no	1.03E-02	3.00E+01	3.44E-04	no
Chromium	1.31E-04	1.53E-04	8.57E-01	no	6.42E-01	1.50E+03	4.28E-04	no
Cobalt	1.89E-05	2.20E+02	8.57E-08	no	3.96E-02	6.00E+01	6.61E-04	no
Copper	1.63E-04	1.46E+02	1.12E-06	no	3.42E-01	3.00E+03	1.14E-04	no
Lead	2.08E-04	1.50E+00	1.39E-04	no	4.37E-01	1.50E+02	2.91E-03	no
Magnesium	4.86E-01	NV		na	1.02E+03	3.00E+04	3.41E-02	no
Manganese	6.12E-04	5.11E-02	1.20E-02	no	1.29E+00	3.00E+03	4.29E-04	no
Nickel	7.59E-06	7.30E+01	1.04E-07	no	1.60E-02	3.00E+03	5.32E-06	no
Phosphorus	2.63E-05	NV		na	5.54E-02	3.00E+02	1.85E-04	no
Selenium	NA	1.83E+01		na	NA	6.00E+02		na
Silver	NA	1.83E+01		na	NA	3.00E+02		na
Thallium	NA	2.56E-01		na	NA	3.00E+02		na
Zinc	3.69E-03	1.10E+03	3.37E-06	no	7.77E+00	3.00E+04	2.59E-04	no
Mercury	1.79E-12	3.13E-01	5.72E-12	no	3.76E-03	1.00E+02	3.76E-05	no

Footnote:
(a) HCl/Cl_2 levels were too low to be reliably measured.
(b) Presence questionable - reported at similar levels in samples and blanks.
NA = Not applicable because compound was not detected.
na = Not available because health-based screening value is not available or not applicable if compound was not detected.
NV = No value
$C_{chronic}$ = Chronic time-averaged concentration ; HBSL = Chronic health-based screening level
C_{acute} = Acute concentration; ATV = Acute toxicity value

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound (a)	**$C_{chronic}$ ($\mu g/m^3$)**	**Health-Based Screening Level ($\mu g/m^3$)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} ($\mu g/m^3$)**	**Acute Toxicity Value ($\mu g/m^3$)**	**C_{acute}/ ATV**	**> 1?**
Total Nonmethane Hydrocarbons (TNMHC)								
TNMHC	4.09E-04	NV		na	NA	NA		na
Volatile Organic Compounds (VOCs)								
Ethane	1.13E-05	NV		na	NA	NA		na
Ethylene	4.75E-05	NV		na	9.98E-02	4.60E+05	2.17E-07	no
Acetylene	5.65E-05	NV		na	NA	NA		na
Propane	NA	NV		na	NA	3.78E+06		na
Propene	1.58E-05	NV		na	NA	NA		na
i-Butane	4.50E-06	NV		na	9.46E-03	5.71E+06	1.66E-09	no
i-Butene	1.13E-05	NV		na	NA	NA		na
1-Butene	2.03E-05	NV		na	NA	NA		na
1,3-Butadiene	2.90E-06	3.74E-03	7.77E-04	no	3.56E-03	2.20E+04	1.62E-07	no
n-Butane	2.03E-05	NV		na	4.27E-02	5.71E+06	7.48E-09	no
trans-2-Butene	NA	NV		na	NA	NA		na
2,2-Dimethylpropane	NA	NV		na	NA	NA		na
cis-2-Butene	NA	NV		na	NA	NA		na
3-Methyl-1-butene	NA	NV		na	NA	NA		na
i-Pentane	2.26E-05	NV		na	4.74E-02	1.80E+06	2.64E-08	no
1-Pentene	NA	NV		na	NA	NA		na
2-Methyl-1-butene	NA	NV		na	NA	NA		na
n-Pentane	1.58E-05	NV		na	3.32E-02	1.80E+06	1.85E-08	no
Isoprene	NA	NV		na	NA	NA		na
trans-2-Pentene	NA	NV		na	NA	NA		na
cis-2-Pentene	NA	NV		na	NA	NA		na
2-Methyl-2-butene	NA	NV		na	NA	NA		na
2,2-Dimethylbutane	6.77E-06	NV		na	1.42E-02	1.80E+06	7.93E-09	no
Cyclopentene	NA	NV		na	NA	NA		na
4-Methyl-1-pentene	NA	NV		na	NA	NA		na
Cyclopentane	NA	NV		na	NA	NA		na
2,3-Dimethylbutane	4.50E-06	NV		na	NA	NA		na
cis-4-Methyl-2-pentene	NA	NV		na	NA	NA		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
2-Methylpentane	1.35E-05	NV		na	2.84E-02	1.80E+06	1.58E-08	no
3-Methylpentane	NA	NV		na	NA	NA		na
2-Methyl-1-pentene	NA	NV		na	NA	NA		na
1-Hexene	9.08E-06	NV		na	1.91E-02	1.03E+05	1.85E-07	no
n-Hexane	9.04E-06	2.10E+02	4.30E-08	no	1.90E-02	5.28E+05	3.60E-08	no
trans-2-Hexene	NA	NV		na	NA	NA		na
2-Methyl-2-pentene	NA	NV		na	NA	NA		na
cis-2-Hexene	NA	NV		na	NA	NA		na
Methylcyclopentane	9.08E-06	NV		na	NA	NA		na
2,4-Dimethylpentane	NA	NV		na	NA	NA		na
Benzene	3.49E-05	2.50E-01	1.40E-04	no	4.28E-02	1.56E+05	2.74E-07	no
Cyclohexane	9.00E-06	NV		na	1.89E-02	3.10E+06	6.11E-09	no
2-Methylhexane	NA	NV		na	NA	NA		na
2,3-Dimethylpentane	9.00E-06	NV		na	NA	NA		na
3-Methylhexane	9.08E-06	NV		na	NA	NA		na
2,2,4-Trimethylpentane	1.81E-05	NV		na	3.80E-02	3.50E+05	1.09E-07	no
n-Heptane	4.52E-06	NV		na	9.50E-03	1.80E+06	5.27E-09	no
2,4,4-Trimethyl-1-pentene	NA	NV		na	NA	NA		na
Methylcyclohexane	4.50E-06	3.10E+03	1.45E-09	no	9.46E-03	4.81E+06	1.97E-09	no
2,4,4-Trimethyl-2-pentene	NA	NV		na	NA	NA		na
2,5-Dimethylhexane	NA	NV		na	NA	NA		na
2,4-Dimethylhexane	NA	NV		na	NA	NA		na
2,3,4-Trimethylpentane	NA	NV		na	NA	NA		na
Toluene	4.75E-05	4.02E+02	1.18E-07	no	2.49E-02	1.88E+05	1.33E-07	no
2,3-Dimethylhexane	4.52E-06	NV		na	NA	NA		na
2-Methylheptane	4.54E-06	NV		na	NA	NA		na
3-Ethylhexane	NA	NV		na	NA	NA		na
2,2-Dimethylheptane	NA	NV		na	NA	NA		na
2,2,4-Trimethylhexane	NA	NV		na	NA	NA		na
n-Octane	4.54E-06	NV		na	NA	NA		na
Ethylcyclohexane	NA	NV		na	NA	NA		na
Ethylbenzene	NA	1.10E+03		na	NA	5.43E+05		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound (a)	**$C_{chronic}$ ($\mu g/m^3$)**	**Health-Based Screening Level ($\mu g/m^3$)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} ($\mu g/m^3$)**	**Acute Toxicity Value ($\mu g/m^3$)**	**C_{acute}/ ATV**	**> 1?**
m-Xylene & p-Xylene	NA	NV		na	NA	6.51E+05		na
Styrene	1.99E-04	1.10E+03	1.81E-07	no	1.05E-01	2.13E+05	4.91E-07	no
o-Xylene	NA	7.30E+03		na	NA	6.51E+05		na
n-Nonane	2.93E-05	4.02E+02	7.30E-08	no	6.17E-02	1.05E+06	5.88E-08	no
i-Propylbenzene	NA	4.00E+02		na	NA	NA		na
n-Propylbenzene	NA	3.65E+01		na	NA	NA		na
p-Ethyltoluene	4.54E-06	NV		na	9.55E-03	1.25E+05	7.64E-08	no
m-Ethyltoluene	NA	NV		na	NA	NA		na
1,3,5-Trimethylbenzene	NA	6.20E+00		na	NA	3.68E+05		na
o-Ethyltoluene	9.00E-06	NV		na	1.89E-02	7.50E+02	2.52E-05	no
1,2,4-Trimethylbenzene & sec-Butylbenzene	4.50E-06	6.21E+00	7.25E-07	no	9.46E-03	1.80E+05	5.25E-08	no
n-Decane	4.50E-06	NV		na	9.46E-03	4.37E+03	2.17E-06	no
alpha-Pinene	NA	NV		na	NA	4.00E+04		na
beta-Pinene	NA	NV		na	NA	NA		na
delta 3-Carene	NA	NV		na	NA	NA		na
d-Limonene	NA	NV		na	NA	1.95E+06		na
MTBE	2.93E-05	3.10E+03	9.45E-09	no	6.16E-02	4.32E+05	1.43E-07	no
Dichlorodifluoromethane	5.52E-07	2.10E+02	2.63E-09	no	1.16E-03	1.48E+07	7.83E-11	no
Methylchloride	NA	NV		na	NA	NA		na
Dichlorotetrafluoroethane	NA	NV		na	NA	NA		na
Chloroethene	NA	2.20E-02		na	NA	1.28E+04		na
1,3-Butadiene	3.92E-06	3.74E-03	1.05E-03	no	4.81E-03	2.20E+04	2.19E-07	no
Methylbromide	NA	5.20E+00		na	NA	5.82E+04		na
Ethylchloride	2.63E-06	2.30E+00	1.14E-06	no	1.29E-02	7.92E+06	1.63E-09	no
Trichloromonofluoromethane	5.22E-06	7.30E+02	7.15E-09	no	1.10E-02	2.81E+06	3.91E-09	no
Vinylidenechloride	NA	NV		na	NA	7.92E+04		na
Methylenechloride	2.07E-04	4.10E+00	5.04E-05	no	2.54E-01	6.96E+05	3.64E-07	no
Allylchloride	NA	1.00E+00		na	NA	9.39E+03		na
1,1,2-Trichloro-1,2,2-trifluoroethane	2.72E-06	3.13E+04	8.70E-11	no	5.72E-03	9.58E+06	5.97E-10	no
1,1-Dichloroethane	NA	5.21E+02		na	NA	1.21E+06		na
1,2-Dichloroethene	NA	3.29E+01		na	NA	2.38E+06		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound (a)	**$C_{chronic}$ ($\mu g/m^3$)**	**Health-Based Screening Level ($\mu g/m^3$)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} ($\mu g/m^3$)**	**Acute Toxicity Value ($\mu g/m^3$)**	**C_{acute}/ ATV**	**> 1?**
Chloroform	NA	8.40E-02		na	NA	9.76E+03		na
1,2-Dichloroethane	NA	7.39E-02		na	NA	8.08E+03		na
Methylchloroform	6.00E-07	1.00E+03	6.00E-10	no	1.26E-03	1.91E+06	6.62E-10	no
Benzene	3.55E-05	2.50E-01	1.42E-04	no	1.74E-01	1.60E+05	1.09E-06	no
Carbontetrachloride	5.79E-06	1.04E+03	5.55E-09	no	3.04E-03	1.28E+05	2.38E-08	no
1,2-Dichloropropane	NA	9.89E-02		na	NA	5.08E+05		na
Trichloroethylene	NA	1.12E+00		na	NA	5.37E+05		na
cis 1,3-Dichloro-1-propene	NA	NV		na	NA	1.14E+04		na
trans 1,3-Dichloro-1-propene	NA	NV		na	NA	NA		na
1,1,2-Trichloroethane	NA	1.20E-01		na	NA	1.64E+05		na
Toluene	4.83E-05	4.02E+02	1.20E-07	no	2.54E-02	1.88E+05	1.35E-07	no
1,2-Dibromoethane	NA	8.73E-03		na	NA	1.54E+05		na
Perchloroethylene	NA	3.31E+00		na	NA	6.89E+05		na
Chlorobenzene	NA	6.20E+01		na	NA	1.38E+05		na
Ethylbenzene	NA	1.10E+03		na	NA	4.34E+03		na
m&p-Xylene	NA	7.30E+02		na	NA	6.51E+05		na
Styrene	2.02E-04	1.06E+03	1.91E-07	no	1.06E-01	2.13E+05	4.99E-07	no
1,1,2,2-Tetrachloroethane	NA	3.31E-02		na	NA	2.06E+04		na
o-Xylene	NA	7.30E+02		na	NA	6.51E+05		na
p-Ethyltoluene	4.62E-06	NV		na	9.71E-03	1.25E+05	7.77E-08	no
1,3,5-Trimethylbenzene	9.15E-06	6.21E+00	1.47E-06	no	1.92E-02	3.68E+05	5.22E-08	no
1,2,4-Trimethylbenzene	4.58E-06	6.21E+00	7.37E-07	no	9.62E-03	1.80E+05	5.34E-08	no
Benzylchloride	NA	4.00E-02		na	NA	5.20E+03		na
m-Dichlorobenzene	NA	3.30E+00		na	NA	3.61E+04		na
p-Dichlorobenzene	NA	2.80E-01		na	NA	6.61E+05		na
o-Dichlorobenzene	NA	2.09E+02		na	NA	3.01E+05		na
1,2,4-Trichlorobenzene	NA	NV		na	NA	3.71E+04		na
Hexachlorobutadiene	NA	8.73E-02		na	NA	3.21E+04		na
trans-1,2-Dichloroethene	NA	7.30E+01		na	NA	4.95E+04		na
o-Chlorotoluene	NA	7.30E+01		na	NA	3.88E+05		na
p-Chlorotoluene	NA	NV		na	NA	3.88E+05		na
1,3,5-Trichlorobenzene	NA	NV		na	NA	NA		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound (a)	**$C_{chronic}$ ($\mu g/m^3$)**	**Health-Based Screening Level ($\mu g/m^3$)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} ($\mu g/m^3$)**	**Acute Toxicity Value ($\mu g/m^3$)**	**C_{acute}/ ATV**	**> 1?**
1,2,3-Trichlorobenzene	NA	NV		na	NA	5.00E+04		na
Methylnitrite	8.93E-06	NV		na	NA	NA		na
Acetonitrile	NA	6.20E+01		na	NA	1.01E+05		na
Acrylonitrile	NA	2.80E-02		na	NA	2.20E+04		na
Nitromethane	6.61E-05	NV		na	1.39E-01	1.50E+05	9.27E-07	no
Benzonitrile	NA	NV		na	NA	1.50E+04		na
Nitrobenzene	NA	2.09E+00		na	NA	1.51E+04		na
Carbonyl Sulfide	NA	NV		na	NA	9.84E+03		na
Sulfur Dioxide	NA	NV		na	NA	7.80E+02		na
Carbon Disulfide	1.65E-05	7.30E+02	2.26E-08	no	3.48E-02	3.73E+04	9.31E-07	no
Thiophene	NA	NV		na	NA	NA		na
Dimethyldisulfide	NA	NV		na	NA	4.00E+01		na
2-Methylthiophene	NA	NV		na	NA	NA		na
3-Methylthiophene	NA	NV		na	NA	NA		na
Dimethyltrisulfide	NA	NV		na	NA	NA		na
Isothiocyanatomethane	NA	NV		na	NA	NA		na
2-Chlorothiophene	NA	NV		na	NA	NA		na
3-Chlorothiophene	NA	NV		na	NA	NA		na
2-Thiophenecarboxaldehyde	NA	NV		na	NA	NA		na
Naphthalene	1.59E-05	3.13E+00	5.07E-06	no	3.33E-02	7.86E+04	4.24E-07	no
Acetaldehyde	4.91E-06	8.70E-01	5.64E-06	no	6.02E-03	1.80E+04	3.34E-07	no
Acrolein	1.34E-05	2.10E-02	6.40E-04	no	7.06E-03	2.30E+02	3.07E-05	no
Acetone	4.74E-05	3.40E+02	1.39E-07	no	9.97E-02	2.37E+06	4.21E-08	no
Propanal	1.25E-05	NV		na	2.62E-02	7.50E+04	3.49E-07	no
Furan	NA	3.70E+00		na	NA	1.67E+02		na
2-Propanol	NA	NV		na	NA	9.84E+05		na
2-Methylpropanal	NA	NV		na	NA	NA		na
Methacrolein	NA	NV		na	NA	NA		na
2,3-Butanedione	NA	NV		na	NA	NA		na
Methyl-Vinyl Ketone	NA	NV		na	NA	8.61E+01		na
MTBE	1.37E-05	3.10E+03	4.43E-09	no	2.89E-02	4.32E+05	6.68E-08	no
Butanal	NA	NV		na	NA	7.38E+04		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
2-Butanone	1.37E-05	1.00E+03	1.37E-08	no	2.89E-02	8.85E+05	3.27E-08	no
Tetrahydrofuran	NA	9.89E-01		na	NA	7.38E+05		na
2-Methyl-1-propanol	NA	1.10E+03		na	NA	4.55E+05		na
trans-2-Butenal	NA	3.54E-03		na	NA	NA		na
Acetic Acid	NA	NV		na	NA	3.68E+04		na
2-Pentanone	4.70E-05	NV		na	9.89E-02	8.80E+05	1.12E-07	no
Pentanal	NA	NV		na	NA	NA		na
4-Methyl-2-pentanone	NA	8.30E+01		na	NA	3.07E+05		na
trans-2-Pentenal	NA	NV		na	NA	NA		na
Cyclopentanone	NA	NV		na	NA	NA		na
2-Hexanone	NA	5.11E+00		na	NA	4.09E+04		na
Hexanal	NA	NV		na	NA	NA		na
3-Furaldehyde	NA	NV		na	NA	NA		na
Butyl Acetate	NA	NV		na	NA	NA		na
2-Furaldehyde	NA	5.20E+01		na	NA	7.86E+03		na
trans-2-Hexenal	NA	NV		na	NA	NA		na
1-Hexanol	NA	NV		na	NA	8.36E+03		na
3-Heptanone	9.75E-06	NV		na	NA	NA		na
2-Heptanone	NA	NV		na	NA	1.70E+03		na
Heptanal	6.10E-06	NV		na	NA	NA		na
trans-2-Heptenal	NA	NV		na	NA	NA		na
5-Methyl-2-furaldehyde	NA	NV		na	NA	NA		na
6-Methyl-2-heptanone	NA	NV		na	NA	NA		na
Benzaldehyde	6.17E-05	3.70E+02	1.67E-07	no	1.30E-01	1.50E+04	8.65E-06	no
1-Heptanol	NA	NV		na	NA	NA		na
6-Methyl-5-hepten-2-one	NA	NV		na	NA	NA		na
2-Octanone	NA	NV		na	NA	NA		na
Octanal	2.22E-05	NV		na	NA	NA		na
Benzofuran	NA	NV		na	NA	NA		na
trans-2-Octenal	NA	NV		na	NA	NA		na
Acetophenone	6.27E-06	2.10E-02	2.99E-04	no	1.32E-02	3.00E+04	4.40E-07	no
2-Nonanone	NA	NV		na	NA	NA		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound (a)	**$C_{chronic}$ ($\mu g/m^3$)**	**Health-Based Screening Level ($\mu g/m^3$)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} ($\mu g/m^3$)**	**Acute Toxicity Value ($\mu g/m^3$)**	**C_{acute}/ ATV**	**> 1?**
Nonanal	1.24E-05	NV		na	NA	NA		na
trans-2-Nonenal	NA	NV		na	NA	NA		na
2-Decanone	NA	NV		na	NA	NA		na
Decanal	NA	NV		na	NA	NA		na

Footnotes:
(a) Items in bold represent duplicate values for those compounds that are common for Method TO-14 and TO-12.
NA = Not applicable
na = Not available because health-based screening value is not available or not applicable because compound was not detected.
NV = No value
$C_{chronic}$ = Chronic time-averaged concentration
HBSL = Chronic health-based screening level
C_{acute} = Acute concentration
ATV = Acute toxicity value

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound	**$C_{chronic}$ (µg/m^3)**	**Health-Based Screening Level (µg/m^3)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} (µg/m^3)**	**Acute Toxicity Value (µg/m^3)**	**C_{acute}/ ATV**	**> 1?**
Particulate/Vapor-phase SVOCs								
N-Nitrosodimethylamine	NA	1.40E-04		na	NA	2.50E+03		na
Pyridine	NA	3.65E+00		na	NA	4.85E+04		na
2-Picoline	NA	NV		na	NA	NA		na
Methyl methanesulfonate	NA	NV		na	NA	NA		na
N-Nitrosomethylethylamine	NA	3.06E-04		na	NA	NA		na
N-Nitrosodiethylamine	NA	4.47E-05		na	NA	NA		na
Ethyl methanesulfonate	NA	NV		na	NA	NA		na
Phenol	NA	2.19E+03		na	NA	3.85E+05		na
Aniline	NA	1.06E+00		na	NA	2.29E+04		na
bis(2-Chloroethyl)ether	NA	5.80E-03		na	NA	5.85E+04		na
Pentachloroethane	NA	NV		na	NA	NA		na
2-Chlorophenol	NA	1.80E+01		na	NA	5.25E+03		na
1,3-Dichlorobenzene	NA	NV		na	NA	NA		na
1,4-Dichlorobenzene	NA	2.80E-01		na	NA	6.61E+05		na
Benzyl alcohol	NA	1.10E+03		na	NA	5.53E+04		na
2-Methylphenol	NA	NV		na	NA	6.63E+04		na
1,2-Dichlorobenzene	NA	2.09E+02		na	NA	3.01E+05		na
bis(2-Chloroisopropyl)ether	NA	1.92E-01		na	NA	6.99E+04		na
o-Toluidine	NA	2.80E-02		na	NA	2.63E+04		na
4-Methylphenol/3-Methylphenol	NA	NV		na	NA	6.63E+04		na
N-Nitroso-di-n-propylamine	NA	9.61E-04		na	NA	5.32E+03		na
Acetophenone	2.25E-05	2.10E-02	1.07E-03	no	4.72E-02	1.47E+05	3.21E-07	no
N-Nitrosomorpholine	NA	NV		na	NA	3.00E+04		na
N-Nitrosopyrrolidine	NA	3.15E-03		na	NA	NA		na
Hexachloroethane	NA	4.80E-01		na	NA	2.90E+04		na
Nitrobenzene	NA	2.09E+00		na	NA	1.51E+04		na
N-Nitrosopiperidine	NA	NV		na	NA	NA		na
Isophorone	NA	7.08E+00		na	NA	2.83E+04		na
2,4-Dimethylphenol	NA	7.30E+01		na	NA	NA		na
2-Nitrophenol	NA	NV		na	NA	NA		na
bis(2-Chloroethoxy)methane	NA	NV		na	NA	NA		na
Benzoic acid	NA	1.50E+04		na	NA	1.25E+04		na
2,4-Dichlorophenol	NA	1.10E+01		na	NA	3.00E+04		na

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
1,2,4-Trichlorobenzene	NA	NV		na	NA	3.71E+04		na
Naphthalene	1.12E-05	3.13E+00	3.59E-06	no	2.36E-02	7.86E+04	3.00E-07	no
p-Chloroaniline	NA	1.46E+01		na	NA	5.21E+03		na
2,6-Dichlorophenol	NA	NV		na	NA	3.00E+04		na
Hexachloropropene	NA	NV		na	NA	NA		na
Hexachlorobutadiene	NA	8.73E-02		na	NA	3.21E+04		na
Dimethylphenethylamine	NA	NV		na	NA	NA		na
N-Nitroso-di-n-butylamine	NA	1.20E-03		na	NA	NA		na
4-Chloro-3-methylphenol	NA	NV		na	NA	NA		na
Safrole	NA	NV		na	NA	NA		na
2-Methylnaphthalene	NA	NV		na	NA	2.00E+04		na
1,2,4,5-Tetrachlorobenzene	NA	1.10E+00		na	NA	3.00E+04		na
Hexachlorocyclopentadiene	NA	7.30E-02		na	NA	2.23E+02		na
2,4,6-Trichlorophenol	NA	6.20E-01		na	NA	3.00E+04		na
2,4,5-Trichlorophenol	NA	3.70E+02		na	NA	3.00E+04		na
Isosafrole	NA	NV		na	NA	NA		na
2-Chloronaphthalene	NA	2.90E+02		na	NA	6.00E+02		na
2-Nitroaniline	NA	2.10E-01		na	NA	NA		na
1,4-Naphthoquinone	NA	NV		na	NA	2.50E+02		na
Dimethylphthalate	NA	3.65E+04		na	NA	1.50E+04		na
1,3-Dinitrobenzene	NA	3.70E-01		na	NA	3.00E+03		na
2,6-Dinitrotoluene	NA	3.70E+00		na	NA	6.00E+02		na
Acenaphthylene	NA	NV		na	NA	2.00E+02		na
3-Nitroaniline	NA	NV		na	NA	NA		na
4-Nitrophenol	NA	2.90E+01		na	NA	3.00E+04		na
2,4-Dinitrophenol	NA	7.30E+00		na	NA	7.50E+03		na
Acenaphthene	NA	2.20E+02		na	NA	1.25E+03		na
2,4-Dinitrotoluene	NA	7.30E+00		na	NA	6.00E+02		na
Dibenzofuran	NA	1.46E+01		na	NA	1.50E+00		na
Pentachlorobenzene	NA	2.92E+00		na	NA	3.00E+04		na
1-Naphthylamine	NA	NV		na	NA	3.50E+04		na
2-Naphthylamine	NA	NV		na	NA	7.50E+03		na
2,3,4,6-Tetrachlorophenol	NA	1.10E+02		na	NA	NA		na
Diethylphthalate	2.38E-05	2.92E+03	8.15E-09	no	5.00E-02	1.50E+04	3.33E-06	no

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
4-Chlorophenylphenyl ether	NA	NV		na	NA	NA		na
Fluorene	NA	1.46E+02		na	NA	7.50E+04		na
5-Nitro-o-toluidine	NA	2.00E-01		na	NA	NA		na
4-Nitroaniline	NA	NV		na	NA	9.00E+03		na
4,6-Dinitro-2-methylphenol	NA	3.65E-01		na	NA	5.00E+02		na
Diphenylamine/N-NitrosoDPA	NA	NV		na	NA	2.50E+03		na
sym-Trinitrobenzene	NA	1.10E+02		na	NA	3.00E+04		na
Diallate	NA	1.10E-01		na	NA	NA		na
Phenacetin	NA	NV		na	NA	3.00E+04		na
4-Bromophenylphenyl ether	NA	NV		na	NA	NA		na
Hexachlorobenzene	NA	4.18E-03		na	NA	7.50E+01		na
4-Aminobiphenyl	NA	NV		na	NA	1.50E+03		na
Pronamide	NA	2.74E+02		na	NA	NA		na
Pentachlorophenol	NA	5.60E-02		na	NA	1.50E+03		na
Pentachloronitrobenzene	NA	2.59E-02		na	NA	1.50E+03		na
Phenanthrene	NA	NV		na	NA	2.00E+03		na
Anthracene	NA	1.10E+03		na	NA	6.00E+03		na
Carbazole	NA	3.36E-01		na	NA	NA		na
Di-n-butylphthalate	3.97E-05	3.65E+02	1.09E-07	no	8.35E-02	1.50E+04	5.57E-06	no
4-Nitroquinoline-1-oxide	NA	NV		na	NA	NA		na
Methapyrilene	NA	NV		na	NA	NA		na
Fluoranthene	NA	1.50E+02		na	NA	3.00E+01		na
Benzidine	NA	2.90E-05		na	NA	5.00E+02		na
Pyrene	NA	NV		na	NA	1.50E+04		na
p-Dimethylaminoazobenzene	NA	NV		na	NA	7.50E+04		na
Chlorobenzilate	NA	2.49E-02		na	NA	2.50E+02		na
Kepone	NA	3.74E-04		na	NA	1.00E+02		na
Butylbenzylphthalate	1.85E-05	7.30E+02	2.53E-08	no	3.88E-02	5.00E+05	7.77E-08	no
3,3'-Dimethylbenzidine	NA	7.30E-04		na	NA	3.00E+00		na
2-Acetylaminofluorene	NA	NV		na	NA	2.50E+03		na
bis(2-Ethylhexyl)phthalate	1.75E-05	4.80E-01	3.65E-05	no	8.61E-02	1.00E+04	8.61E-06	no
3,3'-Dichlorobenzidine	NA	1.50E-02		na	NA	6.21E+03		na
Benz(a)anthracene	NA	2.20E-02		na	NA	6.00E+02		na
Chrysene	NA	2.17E+00		na	NA	2.00E+02		na

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

	Simulator Surface Trip Flare							
Compound	**$C_{chronic}$ ($\mu g/m^3$)**	**Health-Based Screening Level ($\mu g/m^3$)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} ($\mu g/m^3$)**	**Acute Toxicity Value ($\mu g/m^3$)**	**C_{acute}/ ATV**	**> 1?**
Di-n-octylphthalate	1.09E-05	7.30E+01	1.50E-07	no	2.30E-02	1.50E+05	1.53E-07	no
7,12-Dimethylbenz(a)anthracene	NA	NV		na	NA	NA		na
Benzo(b)fluoranthene	NA	2.20E-02		na	NA	NA		na
Benzo(k)fluoranthene	NA	2.20E-01		na	NA	NA		na
Benz(a)pyrene	NA	2.20E-03		na	NA	7.50E+03		na
3-Methylcholanthrene	NA	NV		na	NA	1.50E+03		na
Indeno(1,2,3-cd)pyrene	NA	2.17E-02		na	NA	NA		na
Dibenz(a,h)anthracene	NA	2.17E-03		na	NA	3.00E+04		na
Benzo(g,h,i)perylene	NA	NV		na	NA	3.00E+04		na

Footnotes:
NA = Not applicable
na = Not available because health-based screening value is not available or not applicable because compound was not detected.
NV = No value
$C_{chronic}$ = Chronic time-averaged concentration
HBSL = Chronic health-based screening level
C_{acute} = Acute concentration
ATV = Acute toxicity value

Table D-4: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons

	Simulator Surface Trip Flare			
Compound (a)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)
	Aliphatic:C<=8	***Aliphatic:C>8***	***Aromatic:C<=8***	***Aromatic:C>8***
Propene	1.58E-05	NA	NA	NA
i-Butane	4.50E-06	NA	NA	NA
i-Butene	1.13E-05	NA	NA	NA
1-Butene	2.03E-05	NA	NA	NA
n-Butane	2.03E-05	NA	NA	NA
i-Pentane	2.26E-05	NA	NA	NA
n-Pentane	1.58E-05	NA	NA	NA
2,2-Dimethylbutane	6.77E-06	NA	NA	NA
2,3-Dimethylbutane	4.50E-06	NA	NA	NA
2-Methylpentane	1.35E-05	NA	NA	NA
1-Hexene	9.08E-06	NA	NA	NA
n-Hexane	9.04E-06	NA	NA	NA
Methylcyclopentane	9.08E-06	NA	NA	NA
Benzene	NA	NA	8.15E-05	NA
Cyclohexane	9.00E-06	NA	NA	NA
2,3-Dimethylpentane	9.00E-06	NA	NA	NA
3-Methylhexane	9.08E-06	NA	NA	NA
2,2,4-Trimethylpentane	1.81E-05	NA	NA	NA
n-Heptane	4.52E-06	NA	NA	NA
Methylcyclohexane	4.50E-06	NA	NA	NA
Toluene	NA	NA	4.75E-05	NA
2,3-Dimethylhexane	4.52E-06	NA	NA	NA
2-Methylheptane	4.54E-06	NA	NA	NA
n-Octane	4.54E-06	NA	NA	NA
Styrene	NA	NA	NA	1.99E-04
n-Nonane	NA	2.93E-05	NA	NA
p-Ethyltoluene	NA	NA	NA	4.54E-06

Table D-4: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons

	Simulator Surface Trip Flare			
Compound (a)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)
	Aliphatic:C<=8	***Aliphatic:C>8***	***Aromatic:C<=8***	***Aromatic:C>8***
o-Ethyltoluene	NA	NA	NA	9.00E-06
1,2,4-Trimethylbenzene & sec-Butylbenzene	NA	NA	NA	4.50E-06
n-Decane	NA	NA	NA	4.50E-06
Benzene	NA	NA	8.28E-05	NA
Toluene	NA	NA	4.83E-05	NA
Styrene	NA	NA	NA	2.02E-04
p-Ethyltoluene	NA	NA	NA	4.62E-06
1,3,5-Trimethylbenzene	NA	NA	NA	9.15E-06
1,2,4-Trimethylbenzene	NA	NA	NA	4.58E-06
Naphthalene	NA	NA	NA	1.59E-05
Naphthalene	NA	NA	NA	1.12E-05
Total (µg/m^3)	2.30E-04	2.93E-05	1.31E-04	2.45E-04
Derived Health-Based Screening Level	1.92E+04	1.04E+03	4.17E+02	2.09E+02
$C_{chronic}$/HBSL	1.20E-08	2.81E-08	3.14E-07	1.18E-06
>1?	no	no	no	no

Footnotes:
(a) Items in bold represent duplicate values: highest concentration was used to estimate total petroleum hydrocarbon concentration
>1? = Is the ratio greater than one?
NA = Not Applicable because compound was not detected
$C_{chronic}$ = chronic averaged air Concentration
HBSL = Health-Based Screening Level

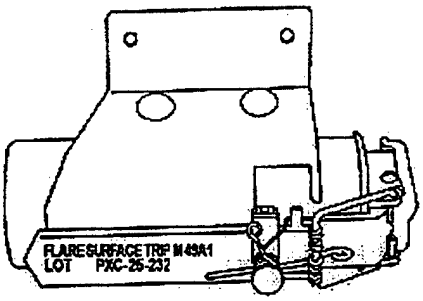
APPENDIX E

FACT SHEET SUBMITTED TO AEC

United States Army Environmental Center
Pyrotechnics Fact Sheet

M49A1 Surface Trip Flare

Department of Defense Identification Code: L495



Breathing air emissions from the surface trip flare will not impact the health of residents who live near Army training facilities.

WHAT ARE PYROTECHNICS?

The terms pyrotechnics and fireworks are often used interchangeably. Pyrotechnics give off smoke, light, and/or a loud noise when activated. The military uses pyrotechnics for signaling, obscuring, and illuminating during training and combat.

WHAT IS THE SURFACE TRIP FLARE?

Surface trip flares are a type of pyrotechnics used primarily to warn our service men and women of infiltrating troops by lighting up the field. They are also used for signaling.

The surface trip flare is about 5 inches long and 3 inches wide. When loaded, it weighs about 0.75 pounds.

HOW IS THE SURFACE TRIP FLARE USED?

To prepare the surface trip flare for use, it is first attached to a sturdy object and a 50-foot trip wire is run across a path that is likely to be crossed by the enemy. When someone stumbles over this trip wire, the trip flare is set off, producing a very bright light that can burn for up to one minute. The bright light lights up the field, revealing the enemy's position and warning our troops that someone is coming.

WHERE IS THE SURFACE TRIP FLARE USED?

Many Army training events use the surface trip flare. Nearly every Army training installation holds these events. At most locations, the training areas are at least 1000 meters (over half a mile) away from populated areas. In general, about three surface trip flares are used every eight hours during a day of training, which typically occurs five times a year.

WHAT IS IN THE SURFACE TRIP FLARE?

The surface trip flare contains a pyrotechnic charge that provides the

bright light. This mixture is made up mostly of barium nitrate, which is also used to provide the white or green color in commercial or consumer fireworks.

WILL BREATHING AIR EMISSIONS FROM THE SURFACE TRIP FLARE AFFECT MY HEALTH?

To answer this question, the U.S. Army Environmental Center tested the air emissions from the surface trip flare. The U.S. Army Center for Health Promotion and Preventive Medicine then determined if there would be a potential for health effects from inhalation to residents living near training areas. Study results showed that residents breathing air as close as 100 meters (328 feet) from the activation site are safe from these emissions.

HOW WAS THE STUDY DONE?

To gather data for the study, airborne emissions data was collected by activating the surface trip flare in a test chamber. The air in the chamber was tested to identify the types and amounts of substances released. More than 300 substances were looked for during this part of the study.

This information was then used in an air model (a computer program that allows estimation of air concentrations) to determine the amount of each substance, to which someone living near a training site might be exposed. Downwind concentrations were estimated based on a typical use scenario for the surface trip flare. Since the study does not look at a specific training area, the assumptions used in the model will in most cases, predict higher downwind air concentrations than those expected at an actual training site.

These estimated air concentrations were then compared to safe screening levels established by the U.S. Environmental Protection Agency and other agencies. If the air concentrations are below these screening levels, they are considered safe for everyone, including sensitive people such as the sick, elderly, and children.

WHAT ARE THE LIMITATIONS OF THIS STUDY?

Many steps were taken to ensure that the results of this study are protective of everyone who lives close to training areas. However, limitations do exist with this study. For example, the study does not consider exposure to other types of munitions that could also be used during the same training event. Due to these limitations, conservative model conditions were used to ensure the protection of public health from inhalation of the surface trip flare air emissions.

WHERE CAN I GET MORE INFORMATION?

Additional information on the surface trip flare and other military munitions can be obtained by calling the Army Environmental Center Hotline at 1-800-USA-3845 or email to t2hotline@aec.apgea.army.mil. Please also visit our website at www.aec.army.mil